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AN ECLIPSE OBSERVER'S EXPERIENCES IN SUMATRA.

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TOTAL eclipses of the sun are often visible only from out-of-the-way corners of the earth, necessitating long journeys from the fixed observatories to observe them. The path of totality of the Sumatra (1901) eclipse extended from the southern Indian Ocean near the African coast northeast across Mauritius, thence across central Sumatra and the neighboring islands, Borneo, Celebes and New Guinea. The most favorable location, astronomically speaking, was in Sumatra, where the duration of totality was longest and the sun, at the time of the eclipse, was near the zenith. These considerations led nearly all of the expeditions to choose points near Padang as sites for their observing stations.

The two observers* from the Lick Observatory, with four tons of instruments and supplies, sailed from San Francisco on February 19, going by way of Honolulu and Japan to Hong Kong, and thence to Singapore, Batavia and Padang. At Singapore we took a steamer of the Koninklijke Paketvaart Maatschappij for the 500 mile run to Batavia. On the 'Coen' Dutch customs prevailed. The early morning, from daylight to nine o'clock, sees the men promenading the decks or lounging about in pajamas and loose slippers. There is no rising call or call for breakfast. One rises when he pleases (usually early, to take advantage of the coolest part of the day), bathes and breakfasts at will. The ladies appear at breakfast attired in loose

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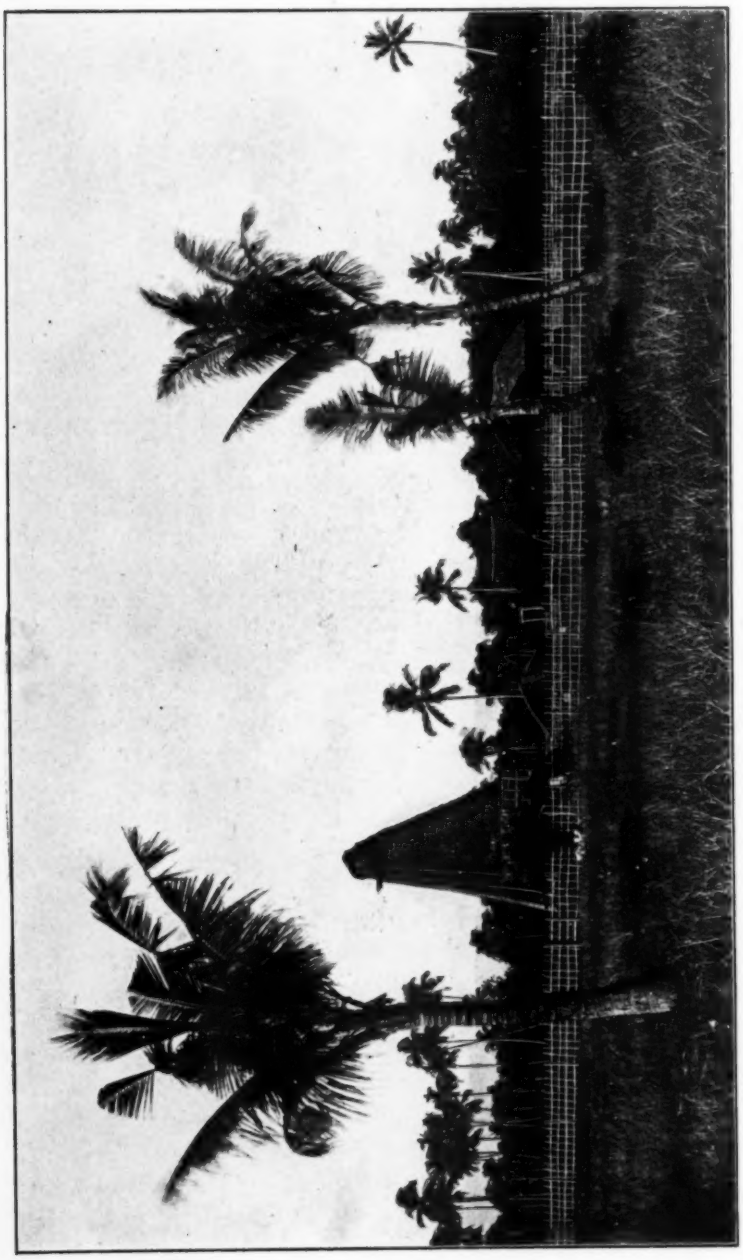


THE LICK OBSERVATORY — CROCKER ECLIPSE STATION.

'mother-hubbards' or in short sarong skirt and loose white sack—the costume of the early part of the day.

The low eastern shore of Sumatra and its fringe of small outlying islands are in view most of the time, presenting an almost unbroken line of green—the dark dense green of tropical vegetation. The cocoa-nut palms afford the only clue to the native villages which are hidden away in groves of these graceful trees. An occasional light-house projects its white shaft skyward from a sand-spit or submerged reef, a grateful relief to the eye from the green which one comes to associate with this part of the world, where even the oranges are green.

About 80 miles south of Singapore we crossed 'the line' and lost our compass-needle, for there is no southern Polaris.

Our time at Batavia was consumed in attending to the transfer of the instruments to the Padang steamer. Owing to the nature of the expedition, and to prevent delays, the handling of the eclipse freight was personally supervised at every change. The officials of the steamship companies were always most courteous in making room for the observers and the instruments on steamers already full, and in meeting our requirements at all points. This was nowhere more true than in Java. For example, during the two full days that the steamer which had the eclipse freight on board was waiting at Tandjong Priok to coal and come to the pier—no one knowing just when these events were to happen—the dock officers and coolies were waiting the entire time, under instructions from the agents of the steamship company, in order to make the transfer at the earliest possible moment.

The steamer for Padang went through the Straits of Sunda, where in 1883 occurred the great outburst of Krakatoa. Soon after entering the Straits we had our first glimpse, just a needle-like point above the horizon, of the torn and shattered remains of the volcano. All about us were evidences of that fearful catastrophe. In front of us was 'Dwars-in-den-weg' (Right in the way), a single island prior to the eruption, but now a group of several islands.

Many stories are heard of this outburst. One, told by a fellow passenger on the 'Prinses Sophie,' a Dutchman who had visited the region a few weeks after the occurrence, concerned a miraculous escape. A trading-ship was lying in the harbor of Telok Betong at the southern end of Sumatra. This town is at the head of a long bay or gulf and is seventy miles or more from Krakatoa. On the morning of the disruption, the captain of the ship was visiting a native prince at his home among the hills. The prince, who had been observing the phenomena on Krakatoa, warned the captain that it would be unsafe to return to his ship and persuaded him to stay. A few hours later the tidal wave came up the bay and carried the ship inland more than

two miles from her moorings, over the town and over a hill eighty feet high.

Early on the morning of April 5, forty-five days after leaving San Francisco, we entered Koninginne Bay, a beautiful little indentation in the precipitous coast of Sumatra. Here is a safe harbor (Emmahaven) where ocean ships go alongside of stone docks. The railroad system of the island has its coast terminus at this point. The coal brought down from the mines in the interior is carried to the ships' bunkers in flat baskets by an endless chain of natives, while the ships are loading with coffee, rice, rattan, gutta-percha, hardwoods and spices of all sorts.

The city of Padang, about four miles north of Emmahaven, is reached by the railroad. Carriages from the two principal hotels were at the railway station, and after a circuitous drive through avenues of trees, our journey was temporarily ended at the Oranje Hotel, 'Het Grootste Hotel van Sumatra.'

My first business was to present my letters of introduction, and to call upon the governor. His Excellency, Governor Joekes, received us cordially and gave the necessary instructions to the heads of all departments who could in any way assist the expedition.

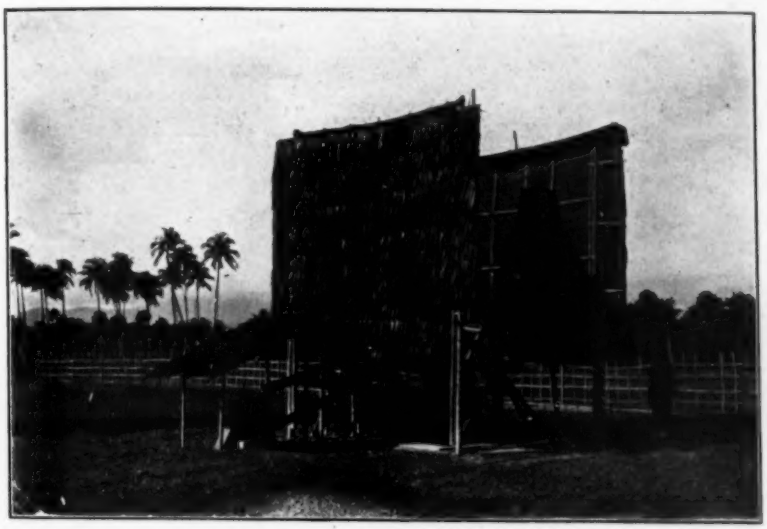
The old race-track (Patuoen Kuda) near the edge of the city was chosen as the site. Shelters for the instruments were built by the native carpenters out of bamboo and atap (palm thatch). A few small cart-loads of these simple materials, which are supplied almost ready for use by a bountiful nature, sufficed to build everything. Shelters, sheds and fence (even to the hinges and fastenings of the gate) were constructed from them.

One orangdjaga (watchman) was employed to guard the small native house at the eclipse camp where the freight was stored and two more to watch the mounted instruments, only a furlong distant. The day after one had been employed to watch the instruments, he came with a frantic appeal for another, because he could not possibly stay alone. Upon questioning him I found that Patuoen Kuda was 'haunted' and that no native would stay there alone at night. A companion was found for him, after which the two were regularly found sound asleep in the midst of things. Their mere presence seemed to be effective, for nothing was missed during our stay.

The advent of so many foreigners, composing the astronomical expeditions, excited great interest among the natives. At first the Malays were disturbed, for they thought the sole object of these foreigners, particularly the British and Americans, was to spy out their country. As the serious preparation for observation began they became less suspicious, but still scouted the idea of an eclipse, saying that 'if these men could foretell such an event, they would be half

god.' The advent of a great comet shortly before the eclipse, and an epidemic in the native kampong, shook the little faith which the natives had acquired in the astronomers. There was a rumor that our camp was to be destroyed. I do not know that there was any real danger, but the police department was on the alert until after the eclipse was over.

The six weeks before the eclipse were busy ones. There were ten telescopes to be mounted and carefully adjusted. Frequent time observations had to be made, experiments were carried out to determine

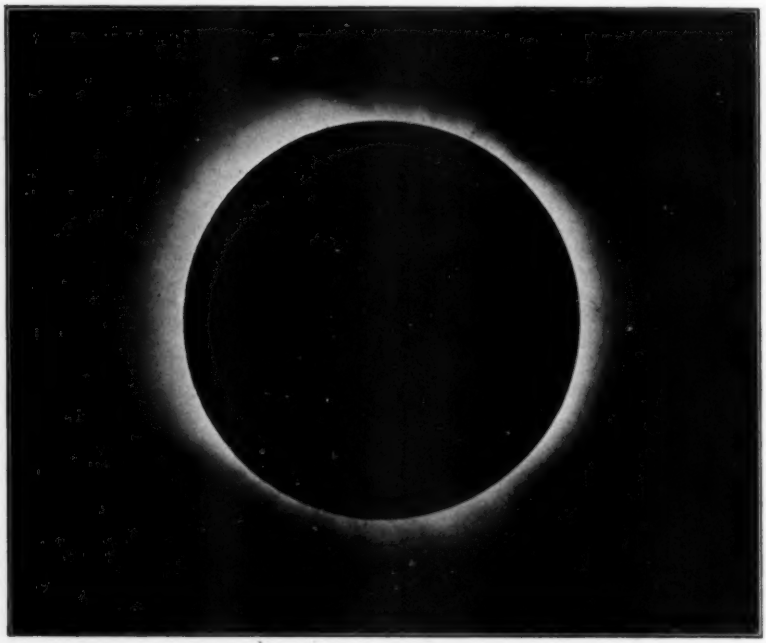


INTRAMERCURIAL CAMERAS (SHUTTER OPEN).

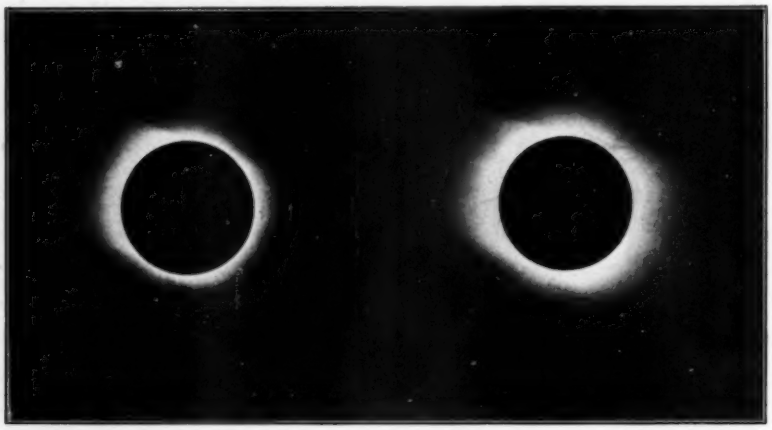
the best methods of developing plates in that climate, for all the observations were to be photographic. A succession of minor difficulties came up for solution.

Our day began at half past five, with a bath. After the Dutch breakfast of cold meat, bread and jam, we were taken to camp by a tram. At 'pocool stenga satoo' (12:30 o'clock) the tram came for us and we were soon drinking an iced 'lemonada' at the Oranje. After a short rest and riztafel (luncheon) we were on our way to work again. In the afternoon the Malay driver turned his pony out to graze at the station, and, finding a comfortable bit of shade, went to sleep until it was time to return to the hotel. This was usually about 6:30, when it became too dark to work. The inevitable 'mandee' (bath) was always the first luxury indulged in upon reaching the hotel in the evening. The 'badkamer' (bath room) was a large room of brick or cement, in a separate pavilion, lighted by a small, high grating in daytime and by a diminutive candle at night. The floor

was of cement. It sloped to a drain at one side, which carried off the bath water. About half of the floor space was occupied by a



THE CORONA OF MAY 18, 1901, PHOTOGRAPHED WITH THE 40-FT. CAMERA, EXPOSURE, 4S.



EXPOSURE, 2S. EXPOSURE, 8S

THE CORONA OF MAY 18, 1901, PHOTOGRAPHED WITH THE FLOYD CAMERA,

cistern two or three feet deep. The only furniture which the room contained was a chair and a small pail. The water was poured over the head, the bather standing on a small platform.

The principal work of preparation was accomplished nearly a week before the eclipse. The remaining time was devoted to arranging the final details and to training the assistants. As soon as it was known that help would be needed to make the observations, it was tendered in abundance by the Dutch residents. Fifteen, including several of the army officers, and the general manager of the government railways, were invited to assist. The observations with each instrument were very minutely planned. Every motion to be made by each observer was carefully considered and arranged beforehand, and numerous rehearsals enabled the operations of taking the photographs to be performed with certainty and great rapidity.

Although light clouds covered the sun during totality, the resulting observations were very successful and yielded much important information. Photographs were secured with three sets of cameras especially designed to record the inner, middle and outer corona. The large-scale photographs of the inner corona showed a peculiarly disturbed region, which later was found to have been at the time of the eclipse above a group of sun spots. The inference that there was a close connection was irresistible.

This eclipse was particularly favorable on account of the great duration of totality—six and one-half minutes—for the search for any planets between Mercury and the sun. Four cameras of long focus were especially designed for the search. They were capable of recording any such objects as faint as the ninth magnitude. The photographs were taken in duplicate to guard against defects. They covered a region 6° wide and 30° long, in the direction of the sun's equator, as the most probable orbit of such a planet would lie in that region. Although the search was not so complete as desired, owing to the clouds, our knowledge was considerably extended. In two thirds of this area, stars fainter than the eighth magnitude were photographed and in the remaining third, stars of sixth magnitude and brighter. All the objects on the plates were identified as known stars. It is practically certain from the observations, therefore, that there is no such planet as bright as fifth magnitude, and little probability of there being any as bright as eighth magnitude. A planet thirty miles in diameter in the region searched would appear as a star of the eighth magnitude. To account for the observed deviations of Mercury from its computed orbit would require *over half a million bodies 30 miles in diameter and as dense as Mercury.*

Another investigation undertaken concerned the nature of the coronal light. The bright coronal lines observed at previous eclipses showed that a small portion, at least, of the light was due to incandescent gases. But the great portion of the light gave a spectrum which appeared to be perfectly continuous. Some observers had

noted a few dark lines in this continuous spectrum, indicating refracted sunlight, while others had failed to find any traces of such lines. By means of two spectrographs designed especially for the problem, and of a camera for photographing polarized light, observations were secured which satisfactorily explain the nature of this light. These observations showed no dark lines and very little polarization in the inner corona, whereas the dark lines and polarization were strongly marked in the outer corona. This seems to indicate that the light of the corona, out to a distance of nearly three hundred thousand miles from the sun's surface, is due to small particles of solid matter in a state of incandescence. This incandescent matter must also reflect light from the photosphere, but the reflected light is too weak, as compared with the inherent light, to show any of the dark lines seen in the spectrum of the sun's surface, or to give much evidence of polarization. The light from the outer corona, being chiefly reflected, gave the same spectrum as the sun's photosphere, and it was found to be very strongly polarized.

These results strengthen the belief that very finely divided solid or liquid matter exists in the region surrounding the sun (together with a very small proportion of gaseous matter); that close to the sun this matter is highly heated and shines principally by its own light; that further away it becomes cooler, and reflects more light than it emits.

On account of the clouds, the eclipse lost its great spectacular interest. Nothing of the corona was to be seen with the naked eye except a faint ring without any structure whatever. The photographs are, however, as sharp, and show as much detail in all except the extreme outer corona, as if the sky had been entirely clear.

With the passing of the shadow and its terrors for these superstitious orientals, confidence in the 'Zoneclips' people was fully restored, and it was difficult to get away from the island without a retinue of volunteer servants.

The U. S. S. 'General Alava' was at Padang during the eclipse preparations, and a number of entertainments were given in honor of her officers and the astronomers. I attended two of these functions, a reception given by the governor, and a farewell ball given by the American consul. The governor's reception was on a Sunday morning at his mansion, and dancing was indulged in for an hour or more. The ball was an evening function and elaborate entertainment was provided. Nice things were said in several languages, and healths were freely drunk. One of the toasts by a prominent Dutch official was to the 'shirt-sleeve astronomers.' These people who had so much cheap native labor, and who never needed to be in a hurry,

were impressed by the methods of astronomers who rolled up their sleeves and did all kinds of manual labor themselves.

The traveler who sets foot in Netherlands India must, within three days of his landing, procure a permit to remain or travel in the country. No charge is made for issuing these 'toelatingskaarten,' but they are made out on government stamped paper, and a guilder and a half collected for the stamp. Upon arriving at a hotel the guest must give a complete account of himself and his movements in a register which is examined every few days by a government official—the resident or assistant resident. Through this means the movements of every traveler, Dutch or foreign, become known to the government. This elaborate and cumbersome system of espionage can not but discourage all except those having urgent business from visiting this interesting corner of the world.

Padang is the capital and principal city of Sumatra. Padang is the native word for plain. It was applied originally to the level stretch of sandy country in which the city is located. The oldest part of the city, the business section, lies along the north bank of a small river, where the native prahus with their cargoes of coffee, rice, spices, etc., from up and down the coast, lie securely sheltered by a high promontory (the Appenberg) across the river to the south. Only the barest ridge of sand, which has been raised by the surf, separates the city from the Indian Ocean. As the tropical seas are ordinarily calm, a murmur is all that usually finds its way to the ears of the inhabitants. To the east rise the steep, heavily wooded slopes of the Barisan range, a dense, greenish black chain from three to five thousand feet in altitude. A wild inhospitable region of tropical jungle it looks and is. In the early morning the sky is often clear, and the mountains free from clouds. At such times the symmetrical cone of the extinct Talang, further inland, is clearly visible. To the north the Singalang and Tandikat, and the Merapi with its plume of smoke, raise their green slopes against the sky.

In Padang are the home of the governor, the government officers, the headquarters of the army and the Staatsspoorweg or government railway. Here also are located the government warehouses, and a branch of the Java Bank, the government banking institution of the colonies. Padang is the center of the coffee trade of Sumatra. Most of the plantations, both government and private, are near the central portion of the island, the crops coming to this point for sale and shipment.

Although the city contains a population of over thirty thousand people, it is difficult to realize the fact; for, situated in a grove of cocoanut trees, it is almost entirely hidden from view. There are about 2,000 Europeans, practically all Dutch, and 5,000 Chinese; the

VIEWS IN PADANG.

'HET GROOTSTE HOTEL VAN SUMATRA.'
'THE MEN . . . FREQUENTLY CARRY NOTHING BUT THEIR DIGNITY OR A DOVE-CAGE.'
THE SHIPS ARE COALED BY AN ENDLESS CHAIN OF MALAYS.

from the adjoining apartments, are features of all the accommodations. The buildings have generally but one story and are raised above the ground three or four feet. They are usually constructed of brick and have cement floors or tiles in the sleeping rooms as well as in the outdoor apartments. With thick tile roofs and overhanging trees they are protected from the direct rays of the sun, but still they are not cool.

remainder are Malays. Here we find the lean-fingered Chinese comprador in the commercial houses, and his cousins in all the trades. Throughout the Dutch possessions the Chinese are heartily disliked and are considered proper subjects of a very searching taxation. Our Chinese interpreter complained that he had to pay a yearly tax on his queue and that another tax prevented his cutting it off. Notwithstanding these measures, they thrive and grow wealthy.

The Oranje, which was our home for two months, like most of the hotels in Netherlands India, is built upon the pavilion plan. The main building contains the dining-room in the center, the out-door reception room in front, and some guest rooms flanking the dining-room. Nearly all the sleeping rooms are in the detached pavilions, and these are the most comfortable. Wide verandas, cut off

VIEWS IN PADANG.
A SHELTER FOR THE POLICEMEN, PADUNG.
A KARBOW CART IN PADANG.

The furniture of the apartments is simple, but very comfortable. A huge, square bed with a canopy of mosquito netting forms the chief feature of the sleeping room. There are no bed covers. A good mattress with thin soft pillows for the head and two long, round, hard, cooling pillows complete the sleeping accommodations. There is an open rack on which to hang the clothes, a small table with its 'goode nacht' light and one or two chairs. The open-air apartment invariably contains a Dutch steamer chair—a most comfortable piece of furniture in a warm climate. A clothes line is stretched in front of each suite of rooms, and one must become accustomed to looking out from behind his wardrobe at his neighbors. Every few days all wearing apparel, particularly the woolens, must be hung in the sun to save them from mildew. Even with these precautions it is practically impossible to preserve shoes, gloves and leather goods from damage.

The call 'Spada' summons one of the numerous servants always near.

The meals at these Dutch hotels are much after the table d'hote system of Europe; one breakfasts when he pleases, but all guests are supposed to have the remaining two meals at the same hours. Before riztafel and dinner, 'spada' brings to the open lobby of the hotel a tray containing the ingredients for the piht, the national drink of the Indies, and leaves it for all guests who care to indulge. Holland gin and a little bitters compose this counterirritant to the climate.

Riztafel is a unique meal. As its name implies, it is composed chiefly of rice. An expanded soup-plate is placed before each guest, and from an immense bowl of steaming, boiled rice, he ladles out a liberal supply. After the rice-bearer follows a procession of barefooted servants with dishes containing chicken, boiled, stewed, fried and roasted; turkey, fried cocoanut, potatoes, gravies, a half dozen kinds of vegetables and lastly an elaborate assortment of condiments and preserves. The guest selects such of these as he wishes, and placing all on his mound of rice, mixes them thoroughly and the *pièce de résistance* is prepared.

The streets of Padang make no more pretensions to being straight than elsewhere in the Orient, but wind about in ways most confusing to the resident of a right-angled republic. The scenes are as unfamiliar as the sounds; the pedestrians and vehicles are jumbled together; there are no familiar lines of buildings anywhere; the canals are filled with native bathers, sousing their heads and rinsing their mouths in the yellow, turbid fluid.

The common beast of burden is the water-buffalo, or karbow—great shuffling creatures looking as docile as lambs. It is difficult to believe that many of the animals which we see on the streets have been wild

'PADANG'S STREETS WIND ABOUT IN WAYS THE MOST CONFUSING.'

in the jungles within a few years. Right noble game they make too, ranking with the elephant and tiger in ferocity and danger. In the rivers one frequently sees what looks like the partly submerged branch of a tree, but which, upon closer inspection, proves to be the horns of several karbow enjoying a bath.

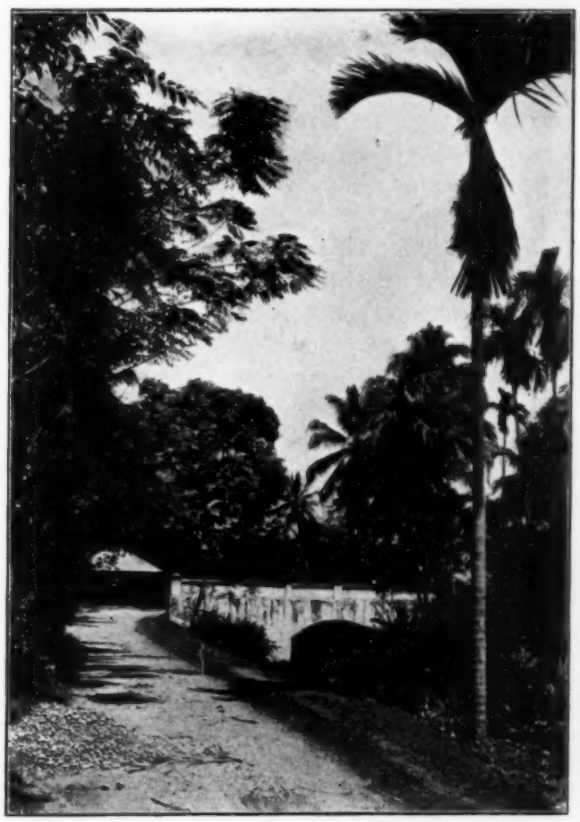
The streets are kept in excellent order for either foot or wheel. There is not a sidewalk in all Padang. The foreigner does not walk much nor far in such a climate, nor does the native if he is fortunate enough to have a fare in his pocket. The ordinary conveyances are two varieties of carts: the dos-a-dos (pronounced dos) with the seats back to back and holding four persons, and the tram with two short seats lengthwise behind the driver's seat. The latter is the more comfortable, if not crowded to its full capacity of five persons. Both varieties are two-wheeled and are drawn by a single diminutive pony of the most contrary disposition. Traveling by this means is cheap, the legal rate being one guilder (40 cents American) per hour. The legal rate is, however, seldom paid if a bargain is made beforehand. As four persons ride as cheaply as one, the Chinese and Malays ride in groups.

At frequent intervals throughout the city are small shelters to protect the policemen and pedestrians from the sudden rains. They are open on one side, and each contains a gong made of a hollow log with a skin stretched across, or sometimes a bell. In cases of fire or crime this gong is beaten to summon help. Many of these shelters contain benches, which are usually occupied in the daytime by some

'Orang Malay,' idly kicking his heels in the air, while his better half passes by with the burden on her head.

We frequently witnessed the operation of repairing worn places in the streets. This work was all done by native prisoners and most elaborately. At first we wondered where the representative of the law was, for no uniform was visible other than the brown one of the convict and the white band of the 'trusty.' Inquiry furnished a more than adequate explanation. The convicts in Sumatra were Javanese, and the hatred between the natives of the two islands is so bitter that there was no danger of prisoners getting away. A similar system was followed in the disposition of native soldiers. To prevent thieves being abroad at night all natives and Chinese were required to carry lights.

Cocoanut trees were plentiful in and around the eclipse camp, and the fruit often furnished a delicious bit of refreshment. No one drinks the milk of the ripened fruit; for this purpose the green nut is selected, before the formation of the meat has begun. One of the native boys



A Side Street in Padang. (Betel Tree in the Foreground.)

would tie a cord around his ankles, which enabled him to get a grip of the straight, branchless trunks. A single blow of the heavy knife which he carried in his belt would send the nut to the ground with a thud that was ample evidence of the danger of being hit by one. The large monkey also gathers the nuts with a skill that is marvelous. He is sent up the tree, with a rope attached to his collar. Selecting the ripe nut, he gets it between his hands and rolls it back and forth until the stem is twisted off, whereupon he throws it to the ground. Stories are not wanting of vicious beasts taking this opportunity of killing their keepers with well-aimed nuts. The cocoanut monkey is the enemy of the baby. If he finds one unguarded, he immediately sets about twisting its head as he would a cocoanut.

The dress and habits of the Dutch are well adapted to the climate. Early rising, usually about daylight, is the rule. After a bath and light breakfast, the serious work of the day is taken up and generally finished by midday, when the heat becomes oppressive. After riztafel all the tropical world goes to sleep. About 5 o'clock life begins to stir again, the more comfortable hour before sunset and the twilight being utilized for the promenade, for calls and for recreation.

During the early part of the day the costume is almost anything one cares to make it, if one is not engaged in official or other business. The gentlemen are usually seen at home or about the hotels in sarong trousers and loose white jackets, sometimes without slippers and usually without hose. This costume is not uncommon on the streets also during the early morning hours. White duck or drilling is usually worn for business. For the afternoon promenade and for evening functions, dark clothes are customary, and most uncomfortable.

The ladies have much the best of etiquette in this land. Their dress is at all times simple and comfortable. A short sarong skirt, reaching only to the ankles, a loose white jacket of some thin stuff, bare feet encased in slippers or sandals, compose the morning or home costume. Their evening dress much resembles that of their sisters in the temperate zones.

It is not until one has been ashore on the low plains that he fully realizes the character of the heavy tropical heat. The air is saturated practically all the time. With a nearly vertical noon-day sun at all times of the year, and with little wind, there is an oppressiveness during the day in these islands that is unknown in temperate climates. One marvels at the windows and doors, without glass and with large slats, and wonders if it is never cool. He soon finds the wisdom of it and courts all breezes, by night as well as by day. Here it is eternal summer, where clothes are not a necessity, but a nuisance, and where one envies the little brown babies the entire lack of raiment which they enjoy for the first few years of their existence.

One is early impressed with the amount of life: the land is overflowing with the human species and the jungles with the lower forms. Even the atmosphere is charged with it; a piece of paper waved through the air gathers the microscopical forms. A lamp is no sooner lighted than a perfect zoo appears. Great beetles three and four inches long go banging around in their crazy fashion, occasionally taking a header down the back of the unwary. The friendly yellow lizards with their queer little squeaks dart about the walls and ceilings catching flies and small bugs. I have counted a dozen of them in my apartments at one time.

Were the insect and reptile life as active as in the temperate regions, the lot of man would indeed be a hard one. The same conditions, however, which tend to keep the human species inactive, affect the pests also. Perhaps the greatest pest of this part of the world is the white ant, a bloated, bleached-out, repulsive little beast. He does not venture out into the light, but woe unto anything organic if it is left in a dark corner for any length of time. He comes from somewhere and immediately sets to work.

The natives of Sumatra are a wilder, freer race than their Javanese relatives, quicker of action, with keener eyes and bolder looks. At only a few points in the Island have they become subject to the Dutch, and nowhere to the extent that one finds in Java. Many of the Sumatranese are still independent. Friction still exists between them and the Dutch, but I was told that a white man could go almost anywhere unmolested.

Much trouble was experienced by the Dutch in the early part of their rule from the Hajjis. These natives, who had made the pilgrimage to Mecca, exerted almost absolute control over the ignorant masses. There were but few of them, and the necessity for keeping them friendly was consequently great—and very expensive. The Dutch hit upon the idea of making many Hajjis.

The Dutch have been very successful in their management of the natives. They do not interfere with the mild form of Mohammedanism practised by the Malays nor do they allow any outside influence to be exerted. No missionaries are permitted to proselyte or teach among the natives, and the few who have found their way into the country are required to confine their efforts to the Chinese or other foreigners.

Almost the first glance shows the status of the sexes. The women are usually seen with large bundles on their heads and in their arms, stepping along briskly, while the men idle about with slouching gait, frequently carrying nothing but their dignity or a dove cage.

The dress of the men usually consists of a pair of gaudily figured sarong trousers and a jacket, with a large square of sarong cloth twisted into a cap. A sarong is usually worn by the men as a sort of badge

of caste. It is thrown over one shoulder or folded about the waist. They seem to be of no real use, but they can not be left aside. The dress of the women consists of two garments only, a sarong skirt and a long coat of figured calico. Small bundles and babies are carried in a sarong worn as a pouch under the left arm. The sarongs are all of brilliant colors and striking patterns, and few are really pretty.

Labor was very cheap, the watchman at the eclipse station being paid 15 guilders per month, equivalent to $6.00 of our money. Ordinary labor was to be had in plenty for three guilders per month, and many a family was supported on such an income.

The Malays have their own particular vices. Ordinarily they are not quarrelsome, but when aroused they can be fiends. Knives are the usual weapons, little crescent-shaped things no longer than the finger. This knife is held, as they hold all knives, between the tips of the fingers. The objective point is the abdomen. I tried to get a knife as a souvenir, but found it impossible, their sale having been prohibited, I was told. The most unique method of taking life is that often practised upon faithless husbands, who are given finely chopped tiger whiskers mixed with their food.

During our stay occurred the yearly celebration of the 'soldiers' of Hasan and Hosain. A motley crowd of natives of all ages, in all sorts of grotesque costumes, with faces painted and carrying banners and symbols, paraded the streets day and evening for a week. Their only attempt at music consisted of discordant sounds from tin pans, sticks, gongs and whistles, subdued, fortunately, by the climate. The object of this exhibition is a superstitious one. When the blowing of trumpets fails to bring their gods to life, the believers gather money, throw an image of some kind into the sea, and subside for another year.

The headland which juts out into the Indian Ocean just south of Padang commands an extensive view of the surrounding country. This Appenberg of the Dutch (or Boekit Munyeet of the Malays) is also interesting on account of its sacred monkeys. One Sunday when we had no pressing duties at the eclipse station, we paid a visit to the hill. The natives visit the hill and its monkeys to perform religious rites. On our way we passed one of their cave temples, with its group of worshippers. From the summit it was impossible to see anything of the city except a few of the warehouses along the river; all else was completely hidden in the great grove of cocoanut trees.

I had the privilege of seeing something of the coffee and spice industry through the courtesy of the American consul, who was extensively engaged in the export trade. He showed me through the 'peeling mill' where the hard outer husk of the coffee berry is removed by machinery (of American manufacture), and through his own and the government's warehouses. Much of the government coffee was

very inferior, said to be due largely to the system of labor. The finer grades of coffee come from the private plantations. The coffee business is a monopoly, the government buying the product at a fixed price and then grading it for market. The price received by the government varies all the way from 15 to 60 guilders per picul, the average being about 40. The consul was very proud of the fact that he had sold the highest priced coffee which ever left Padang—90 guilders the picul, equivalent to about 27 cents of our money per pound. This coffee came to America.

The warehouses were redolent with the odors of all kinds of spices. Bales of cinnamon bark, piles of mace and nutmegs, bins of pepper and cloves attested the fitness of the early name for these islands. All of the spices must be sorted very carefully and many of them tested. For example, the bales of cinnamon bark contained a large portion that was absolutely worthless, put in knowingly by the natives who gathered it. This worthless bark can not be told by sight and so each piece must be *tasted*.

After the instruments had all been packed, and while waiting for the steamer, a short trip was made into the Padang Highlands, where the natives were seen at home in their peculiar horned houses.

This little-visited corner of the world offers an attractive field for the traveler who cares to go off the beaten paths. When the official calls had all been paid and the time came to say 'slamat,' I left the island of Sumatra with many regrets.

PUBLIC INTEREST IN RESEARCH.

By Professor JOHN M. COULTER,
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THE subject I propose to discuss seems to me both timely and important. I recognize that to many scientific men it is a subject to which they are indifferent or which may afford them passing amusement. And yet, there appear in it certain possibilities that may be worth consideration. I do not refer to the general public, to whom information concerning research would be like 'casting pearls before swine,' but to what may be called the intelligent public, the public that thinks and brings things to pass. To develop in proper order what I have in mind, I shall speak of public interest in research under three divisions: (1) its present condition, (2) its possible condition, and (3) its possible results.

1. *Its Present Condition.*

The most available index of the present interest in research is furnished probably by the newspapers and magazines, which try to respond to the desires of their readers. Even a cursory examination of the material they furnish, which may be said to deal with research, shows that it is scant in amount, sensational in form, and usually wide of the mark. The fact that it is scant in amount is a cause for congratulation if it must involve the two other features. The sensational form is a concession to what is conceived to be public taste; and while to a scientific man this form seems to exhibit the worst possible taste, the serious objection is that to secure the form truth is usually sacrificed. That the real significance of an investigation thus reported is usually missed is not to be wondered at, since the reporter is not the investigator and has no scientific perspective whatsoever. Some of the results of this kind of information are as follows:

Men engaged in research are looked upon in general as inoffensive but curious and useless members of the social order. If an investigator now and then touches upon something that the public regards as useful, he is singled out as a glaring exception, and is held up as an example for us all to follow. If an investigation lends itself to announcement in an exceedingly sensational form, as if it were uncovering deep mysteries, the investigator becomes a 'wizard,' and his lightest utterance is treated as an oracle. The result is that if the intelligent reading public were asked to recite the distinguished names in science,

they would name perhaps one or two real investigators unfortunate enough to be in the public eye, several 'wizards' and still more charlatans. The great body of real investigators would be known only to their colleagues, thankful that they were not included in any public hall of fame. And yet the public is not to be blamed, for it is giving its best information; and the fact that it has even such information indicates an interest that would be wiser were it better directed. And this better direction is dammed up behind a wall of professional pride, which makes an investigator look askance at any colleague who has broken through it.

I have been especially interested in noting the rising tide of quasi-scientific papers in the leading magazines, seeking to inform the public of certain striking things and occasionally written by scientific men. These men are bold, if they have their colleagues in mind, but they may have something more important in mind. I judge that from the daily paper to the great magazine is the range of agencies by which research can reach the intelligent but non-scientific public; and the conclusion seems justified that while the daily press is as bad as it can be in this regard, it still voices an interest in such subjects; and that the leading magazines are becoming distinctly stronger in this feature. The intelligent public is certainly interested, but it is just as certainly not intelligently interested.

2. *Its Possible Condition.*

The present condition of public interest in research, as described above, does not seem to invite a large measure of hope that it can be improved, even if this were thought desirable. The desirability of a stimulated and intelligent public interest will be discussed later; for the moment the securing of such interest will be considered. The problem is to substitute information for misinformation, so that interest may become intelligent.

I have taken occasion to discuss this subject with managing editors of newspapers and magazines, and find a general opinion that many subjects of research would be of great interest to the intelligent public, but that such material is the most difficult of all to obtain. This does not mean that such subject matter is difficult to obtain, but that the necessary simplicity and attractiveness of presentation are usually lacking. These editors recognize that when the simplicity and attractiveness must be supplied by a 'middle man,' the result is almost sure to be not only a series of misleading statements, but also a disappearance of the scientific atmosphere. This middle man who stands between science and the magazine public is a curious product of the present situation. He may simply *interpret* for the public, putting the language of science into the language of literature; but when he begins

to *observe* for the public he joins the clan of 'poet-naturalists,' who, as John Burroughs has said, 'hold the eye close to the facts and will not be baffled.' It must be confessed that very seldom are they baffled. The judgment of the editors referred to, therefore, is that the middle-man should be abolished, in so far as he is merely an interpreter. As for the poet-naturalist, he will cease to appear scientific when the middle men are abolished.

This means a distinct invitation to investigators to become their own interpreters, an invitation which will come to most of them with a distinct shock, if not as an absurdity. Taking it seriously, however, and waiving its absurdity for the moment, what is there in the way of accepting the invitation?

The readiest answer to this question is that it would be a waste of time, and under the present conditions the answer seems true. The investigator's chief concern is his investigation; and he does not see how it can be benefited by any information he may give to the public. If such a benefit is not evident, the invitation should be declined; for to accept it under these circumstances is to strain after a little cheap notoriety.

But the invitation involves a change of conditions, a change in the policy of editors, on the one hand, and of investigators on the other. If under the new conditions it can be made to appear worth while to accept the invitation, what is there still in the way? It is not to be expected that investigators in general will undertake to learn the art of popular writing, or will take the time to exercise it if they do not need to learn it. The only thing asked for is a simple statement, in terms that intelligent, but non-scientific, persons can understand, of the nature and bearing of an investigation. This would be authoritative, and would be used, so our friends, the editors, assure us, not only in checking the wild vagaries of the reportorial imagination, but also in bringing to the public a large amount of information which no reporter could discover. Emphasis is to be laid upon the *bearing* of an investigation, for, naturally, this is the point of vital interest to the public, and the point of importance, as I shall show later. For example, I might describe in perfectly simple English the results of some experiments I had performed with evening primroses or with pigeons, and people would simply wonder at the things that amuse some men; but if it were added that these experiments have a bearing upon the origin of species and upon heredity, the investigation at once assumes a dignity and an importance that even the public will be quick to appreciate.

One sees repeatedly in the public press joking, if not sneering, allusions to the immediate subject matter of some investigation, which seems insignificant or even ridiculous to the uninformed, when, in fact,

it has to do with a very important general subject, which would intensely interest the intelligent. I presume that every investigation by an experienced investigator is suggested by its general bearing, the immediate material merely being that which is most available. It is this feature that the reporter always misses, and a strategic movement is represented to the public as a dress parade.

It may be well to intimate here that in all this discussion professional investigators are in mind, and not that host of still-born investigators whose first and last publication is a doctor's thesis.

Just how the clean-cut statements referred to may reach the public, and in what form, are matters of detail which purveyors to the public interest must work out. The general principle is that the investigator's own statement shall be available for such use.

3. *Its Possible Results.*

This is the vital consideration, for all the trouble and the outraged feeling involved must be justified. It means a campaign of education in reference to investigation, an education of the intelligent public. Perhaps it remains to be proved whether this public can become educated in this matter, but the interests at stake seem to make it worth trying. I shall put aside as of secondary importance the more just estimate of investigators that would result, the pulling down of some conspicuous names to a proper level, and the better leveling up of scientific men in general. The present situation in this regard may be irritating and even disgusting, but it is not of sufficient importance to justify what has been proposed. In my judgment, the justification will be found in two results, which, taken together, must seem important to every investigator.

1. *It will show that research is practical.*—I recognize at once, in using this statement, that if the universities have stood for anything, they have stood for what is called 'pure science.' I would be the last one to recommend a departure from this standard, for my thought is to show that pure science is the real foundation for any effective applied science; and that the 'practical science' of popular definition is the rankest empiricism.

A recent and conspicuous illustration in my own field may be cited. When Moore was busying himself with the study of algae, he would have been characterized by the public as highly impractical, for not only were his studies apparently foreign to human interest, but that group of plants is peculiarly within the domain of 'pure science.' However, when he was transferred to the Department of Agriculture, and began to apply his training, the problem of polluted water-supplies, which had cost empiricism, called 'practical science,' many thousands of dollars in attempting to solve, met with almost immediate and bril-

liant solution. The same training has devised inoculation for nitrogen-impoverished soils; and now the public regards Moore as a distinguished example of a scientific man who began to amount to something as soon as he abandoned pure science! The illustration is probably the more striking since the investigator himself applied his pure science; but it illustrates the fact that such practical results are reached most surely and most quickly from the vantage ground of pure science.

What the public needs to know is that an effective and economic applied science must root itself in pure science, just as a tree must root itself in the soil. It was with this in view that I laid emphasis upon the general bearing of an investigation as the important feature of its public report. It need not be a practical bearing, to use 'practical' in its conventional sense; for in many important investigations such a bearing is either lacking or trivial; but simply the real bearing, which, if it does not appeal to the current desire for immediate practical application, does appeal to that better desire for information about important things, to that delight in feeling that the great things are being sought after. The public must be taught that even research that merely means increased knowledge is immensely practical, for it means an attitude of mind, a method, a body of knowledge that must be available for every important problem, whether it happens to be one of economic interest or not.

Such education, as all education, will be slow, but the increasing number of investigators who are being drawn from pure science to applied science will give increasing illustrations of the necessary training for results.

2. *It will secure endowment for research.*—To show to an intelligent public that the investigations in pure science are the only kind that are fundamentally practical would not be worth while if it did not result in a better support of research.

It is clear that the question of adequate support for research is the most serious one that confronts American science to-day. Teaching and administration tax the time and energy of established investigators; the expense of investigation is becoming greater; the opportunities for it in the way of position and equipment are so few that there is no inducement for young men to become investigators. Not equipped for the men we have, the very desirable multiplication of men is impossible. And yet, such equipment as we have is dependent in certain measure upon our output of men. In spite of these conditions, the volume of research is increasing yearly, and young men are still found who will not sell their birthright for a mess of pottage. These conditions will continue to become harder unless some relief is found.

The Carnegie Institution was intended to furnish some relief.

and the great flood of dammed up opportunities that broke loose when this chance offered itself is a matter of record. This endowment, vast as it seemed to any individual, proved to be a mere pittance as compared with the pressing needs of research in America. To choose among these needs was bewildering, and no committee could choose wisely in every instance. But whether the choosing was wise or not has nothing to do with the impressive illustration afforded of the pressing needs of research even in its present stage of development. There is no need at present of a fund to *stimulate* research; what it needs just now is *opportunity*.

What Mr. Carnegie was brought to see, the intelligent American public must be brought to see, for one institution and one board of control can not hope to meet the need. The appeal to American interest is utility, and there is no need to blink the fact. If our relief, therefore, is to come from American interest, we must tell the public what we are doing and of what service it may be; and this is to be done, as I have shown, without any change in our subjects or methods of research. I may say in passing, however, that it has long seemed to me wise to select among profitable subjects of investigation, which are included in our immediate interest, those that may have some bearing upon human interests. Nothing is lost by such a choice, and investigation is strengthened thereby in public estimation. I have not the slightest sympathy with those who select subjects for public effect; but I have also no sympathy for those who avoid them when they come in the natural sequence of work.

Why should not the public expect some tangible service from the large body of men best equipped to render it? This is the question I was asked by a prominent business man whom I was trying to interest in a botanic garden, and after I had explained that such an equipment would make certain important investigations possible that could not be undertaken without it. One may inveigh against this utilitarian point of view, but that it exists is a fact, and it does not alter a fact to despise it. Should it have been expected that this business man would break suddenly with the training of a lifetime, even when a botanic garden with an alluring corollary of experiments was presented suddenly to his vision? It was impossible to educate this particular man in a short time, but had he heard over and over again, for he is interested in horticulture, that the very experiments proposed made possible a better horticulture, he would not have asked such a question. An appreciation of the utility of purely scientific investigations must get into the atmosphere. An atmosphere of appreciation can be created for such non-utilitarian things as music and art, even in a commercially saturated environment, but it is not by keeping still about them or by only revealing them to the cult.

I am afraid that scientific training leads too often to idealism. We know the conditions we should have for our work, and we are impatient with those who do not recognize them. We act as though the suitable conditions should be offered to us freely as our right; and when they are not, we rail at those who could help us but do not. In fact, I have been surprised at the confidence shown in us by those who have no conception of what we are doing, and whom we do not take the trouble to inform. This argues well for the possible results of a persistent general campaign of education.

I have no large faith that there will be any such campaign, for in my experience investigators have cultivated indifference. Each man is anxious for his own investigation, but not troubled to the point of effort about investigation in general. My chief concern is to secure recognition of the fact that we are being treated about as well as we can expect; and that there is an opportunity for us to do better for ourselves, and far better for investigation in general, if we care to avail ourselves of it.

This is not a matter for organization or concerted action on the part of scientific men, but it is the cultivation of a general sentiment among them in favor of giving the public such information as has been suggested; a sentiment that acts when opportunity offers. This general sentiment is absolutely necessary, for, so far as I know, it is all the other way at present; and the man who sees his work reported in the public press shudders a little when he thinks of his colleagues. After all, it is the good opinion of his colleagues that a scientific man prizes most, and rightly; and he must feel them solidly behind him in any new departure.

The attitude of our colleagues across the Atlantic can not be taken as our guide in this matter, for our institutions and our people, whether we approve of them or not, are different. Besides, our European brethren are facing to-day the same problem, and with a much more hopeless outlook. I have been assured by my German colleagues that since their government has become deeply interested in world politics the chances for increased support for research have diminished, and they regard private support as hopeless. We have behind us a public more prosperous and much more generous, accustomed to support liberally what it is interested in. If this can be taken advantage of, there is no reason why research in America can not be developed to an extent that is without precedent.

THE VALUE OF OLD AGE.

By JOHN F. CARGILL.

DO the creative or initiatory faculties of the mind begin to wane at middle life? And would the ransacking of all historical data show that a majority of the greatest things in the world have been achieved by men under forty? To undertake anything like a positive solution of so great a problem is naturally out of the question; but one plain aspect of the matter may be shown—leaving it to the reader, or to some future writer having a passion for statistics, to determine upon which side are ranged the exceptions that prove the rule. It may be said with confidence that one fact is indisputable: We can mention no field in the broad domain of science—including astronomy, geology, biology, psychology, sociology, electromagnetism, electricity, engineering, invention, mathematics or medicine that does not owe much indeed to men of advanced years. This statement holds good of the fields also of mechanics, philosophy, statesmanship, letters, history, finance, music, art, discovery, exploration, navigation and many others.

A noteworthy beginning may be made with the five great savants who, within the hundred years just past, have given to mankind entirely new concepts, new understandings of the universe and of life; have revolutionized the greater sciences, and made it necessary to build anew from the beginning. We will take them in chronological order. Immanuel Kant died in 1804 at the age of seventy-six. His Kritik ('Critique of Pure Reason') was written, or appeared, after he had reached fifty-seven: a work of such vast comprehensiveness, such subtle, active and far-reaching intellectual resourcefulness, that the world has produced but a handful of men since his day who could fully appreciate or appraise him. His 'Contest of the Faculties' appeared when he had passed seventy. His primary formulation of the nebular hypothesis was when he was in the thirties; but much of its elaboration was concluded many years afterward. Pierre de Laplace, his coadjutor in the hypothesis which shook the world, died in 1827 at the age of seventy-eight. Laplace issued the earlier portion of his great 'Exposition du système du monde' at about the age of fifty; and the completion of this monumental work containing the nebular hypothesis was not published until he was past seventy years.

The next great step forward in enlightenment is from the field of astronomy to that of geology, and we come to Sir Charles Lyell, who

died in 1875 at the age of seventy-eight. The most important portions of Lyell's work were done after he had passed forty years; complete and sweeping revisions and enlargements of his earlier work were done late in life, and even down to within three days before his death, at the age of seventy-eight years, he finished a revision of his 'Principles of Geology,' a work which amazed and electrified scientists of all nations, and remains to-day the unchallenged great text-book in that field. Lyell's is the broadest and best-balanced mind which has dealt with deep-lying geological problems. In effect, he may be said to have created the science of geology. His work marked the second epoch in the thought of mankind, supplying the needed second link in the chain of evidence of planetary evolution. He applied in geology the principle of gradual development to the earth's crust, which Laplace and Kant had previously wrought in astronomy concerning sun systems and planets; which Darwin accomplished afterward in biology for living forms and organic life, and Spencer achieved for psychology in human consciousness and thought, and for sociology in human society and government. And, moreover, the fuller amplification of Lyell's work was made after he had passed sixty years.

With Lyell's work planetary evolution came to be a recognized and definite truth; and then came Charles Darwin. Darwin was born in 1809, and lived until the age of seventy-three. His lifelong habits of thought, and his methods of research are too well known to be repeated, but it may be said that up to the age of forty-nine years he devoted himself almost wholly to accumulating stores of experience and observation, and to the planning of the great work which was to come afterward. 'The Origin of Species,' written at the age of fifty, sounded the farthest depth of biological knowledge and created such a whirlwind of controversy as no other book has done. His 'Descent of Man,' written at the age of sixty-two, was not less remarkable, and had an effect almost as widespread and profound. No man then living, either young or old, had the preparation, patience in the working out of details, breadth of mind, modesty or the honest simplicity of character, necessary to the carrying out of his tremendous task. Darwin may not have created the science of biology, but unmistakably he brought it out of a vague, confusing and conflicting state, reduced the mass of evidence and details to concrete form, and made it into an orderly and perfect system.

Herbert Spencer, the latest of this remarkable group of investigators, died in 1904, at the age of eighty-three. Spencer's mind did not begin its best functions until he was well on into the forties. He was storing up until then—his mind was incubating, as it were. At forty he had made merely a rough outline or program of his 'Synthetic Philosophy,' which massive work he was to carry out triumphantly in

his riper and broader years. 'First Principles,' the first work in the series, was finished when he was forty-two years old; 'Principles of Psychology' when he was fifty-two; 'Principles of Sociology' when he was fifty-six and one of the greatest in his ethics series, 'Justice,' came at the age of seventy-one. He was close upon eighty when his monumental 'Synthetic Philosophy' was completed, and the person has not yet appeared who has discovered any diminution of his powers from the earlier work to the last page of the final volume.

The only aspect of the matter that is worth troubling about is the assertion that no creative, original or vitally important work is accomplished by men who have passed forty years. The difficulty is to make selections from the abundance of rich material at hand. We have a casual list, and one of the first names is that of an American. Benjamin Franklin was eighty-four years old when he died in 1790. His early life and achievements do not concern us, and are well known. When he was past sixty he was the chief instrumentality in the repeal of the Stamp Act; and after he had reached seventy years he was the main element of inspiration, energy and brains in the first continental congress. At this period (1776)—when he was at the head of the mission to the court of France in aid of American finance—it is said of Franklin that he was 'one of the most talked-of men in the world.' This mission in its all-around results to America and to the world at large has had no parallel. Its chief elements were the bringing about of an alliance between France and the colonies; and the negotiation of a loan of twenty-six million francs, obtained mainly through his own wonderful personality—it certainly was not upon any established or recognized basis of credit. This, after he was seventy years old. At the age of seventy-seven Franklin was one of three commissioners who negotiated the peace treaty with Great Britain after the revolution. Even at the age of eighty his countrymen considered his services invaluable, and refused to be deprived of them. He devised the most original, valuable, important and far-reaching feature of the constitution of the United States, namely, that which gives the states equal representation in the Senate and representation according to population in the House.

A large book could be filled with equally interesting and pertinent data concerning the achievements of men past middle life; but we may do little else than mention some of them. Christopher Columbus was fifty-six years old when he discovered America; and when he returned from his last voyage to the West Indies and South America he was sixty-eight. Magellan was forty-nine years old when he sailed away upon his globe-girdling voyage—the first man to circumnavigate the world. Baron Humboldt postponed until he reached seventy-six the crowning work of his life, finishing it ('The Kosmos') with high

honor and credit. It is a work which despite certain shortcomings, inevitable on the part of any writer at that date, has been declared a successful attempt to portray the universe. Perhaps more than all else it displays the grand and comprehensive intelligence of a great man even at the age of eighty years and beyond. Goethe was eighty-three when he died. At past sixty he finished his 'Theory of Colors,' and he laid out for himself a completely new field of literary activities after he had reached sixty-five. He finished 'Faust' at eighty, and careful criticism has long ago declared that the second part of 'Faust' is the most important part of the poet's life work. Richard Wagner died at seventy. Wagner did not reach the zenith of his powers until he was fifty. The entire 'Nibelungen Ring' was produced after he was sixty years old; 'Parsifal' was written at sixty-four. Haydn died at seventy-seven; his oratorio, 'The Creation,' was written at sixty-seven years, and 'The Seasons' some years later. Handel died at seventy-four. He composed 'Saul' at fifty-three; his greatest work, 'The Messiah' at fifty-six; 'Belshazzar' at fifty-nine, and other works until he had passed seventy years. Gerome the artist died at eighty. He did not reach his greatest power until after he was forty, and much of his splendid work was done after sixty years. Verestchagin was sixty-three when he was cut off in what might be called the vigor and prime of his work by the blowing up of Admiral Makaroff's flagship a year ago. W. W. Story, the sculptor, died at seventy-six; he was a lawyer and writer of law books in early life, and did not take up sculpture until forty. In this he was eminently successful, as well as in the literary field which he continued almost to the end of his years. Lord Kelvin (Sir William Thomson) is now eighty-one. He was at the head of the department of natural philosophy at the Glasgow University until seventy-two years of age, and his work in the departments of physics and mathematics has continued to the present. After he had passed forty years he originated the mirror galvanometer, and the siphon recorder which solved one of the greatest problems in submarine telegraphy. His works upon navigation, matter, physics and geology, executed after he had passed sixty years, are among his strongest and best. Faraday died at the age of seventy-six. His discoveries of the effect of magnetism upon the polarization of light, and diamagnetism were between the years of fifty and sixty, and many important discoveries in chemistry and electro-magnetism continued until late in life. Dr. O. W. Holmes entertained and delighted the world with his writings until he was eighty, and died at the age of eighty-three. John Fiske did all of his historical work after he reached forty, and the most important of his productions, both historical and philosophical, were after he passed fifty. Commodore Vanderbilt made eighty

millions after he was seventy-five years old. These are but a few of the names at hand.

Coming down to the present day, and to men who are in advanced life, and living and working amongst us, we might mention our beloved Mark Twain, now seventy, who failed in business for a heavy amount at sixty years, has paid his debts to the last dollar and has retrieved his own fortunes, whose writings at three-score and ten are scarcely less amusing than those of his youth, besides being vastly more instructive. Dr. Wier Mitchell is now seventy-six, and after a life of distinguished services to the world in his profession he is still active, and in the present year is completing a work of fiction which is thought to be his best. Dr. Mitchell did not begin writing until he was past forty; since when he has published various scientific works as well as books of fiction. Andrew D. White is now seventy-three, has performed important diplomatic missions up to the age of seventy, and has contributed much to philosophy and letters since he reached sixty. Professor Simon Newcomb, now seventy, did not begin to write until he had passed forty, was called to the chair of mathematics at Johns Hopkins University at the age of forty-nine, and his mind is still undimmed and vigorous. Professor Goldwin Smith is now eighty-two; most of his work has been done since he passed fifty years, he is yet writing, and it is still a pleasure and profit to read anything that comes from his pen. John Hay* is to-day, at th age of sixty-seven, with the exception perhaps of Benjamin Franklin, the greatest diplomat America has ever produced. He was appointed minister to England at the age of fifty-nine and secretary of state at sixty. J. Pierpont Morgan is now sixty-eight; his greatest achievement—the greatest industrial organization the world has ever known—the formation of the United States Steel Corporation, was long after he reached the age of sixty years, and nobody has thus far perceived any weakening of his mental powers. Andrew Carnegie is in his seventieth year; has achieved his uncounted millions since he reached fifty years, and his intellect to-day is sufficiently strong so that when he speaks the whole world pauses to listen.

The world's need of men of advanced years has perhaps never been so well presented as in Nathaniel S. Shaler's book, 'The Individual,' the main purpose of which was to present an account of what man's individual life means in the great order. In considering that valuable work it is well to bear in mind that five years ago, when it was written, Professor Shaler was in his sixtieth year, and that he is still professor of geology in Harvard University and dean of the Lawrence Scientific School.

In the chapter wherein Professor Shaler considers the question of

* This article was in type before the lamented death of John Hay.

the uses of the period of old age, he shows how the presence of three or four generations in a single social edifice gives to it far more value than is afforded by one or two. While the elders may contribute little to the direct profit of the association, they serve to unite the life of the community and bridge the gap between the successive generations. Professor Shaler shows that the average man up to the age of perhaps fifty has little or no time for calm reflection; that the necessities of existence demand that he pursue the gainful life, which is always more or less strenuous. Whatever possible period there may be for the individual to pursue the intellectual life must come afterward. And it does come. Is it necessary to argue that the world needs the assistance of the calm reflective mind? Remove this possibility, and mankind may never be able to learn whether life has either meaning or value—in the larger sense.

Recurring wars, he says, repetitions of political follies and the successions of commercial disasters, all show the need of adding in every possible way to the strength of the bond between generations, so that the life of society may gain a larger unit of action than is afforded by the experience of most of its active members. If the deeds of any single period could be the result of the experience of three or four generations of experienced men, rather than that of one, civilization would be an immense gainer. There would be fewer recitals of failure, fewer reversions toward savagery. This necessity is made evident, he says, because, notwithstanding the resources of our printed records, they convey only imperfectly the quality of one time to that which succeeds it. The real presence of the generations is necessary to the greatest extent that can be had.

He says that the idea of the apparent uselessness of man in advanced years is a survival from the time when a man's value in warfare was the paramount consideration; and he adds, "The generation which has seen an aged Gladstone guide an empire; a von Moltke at the three score limit beat down France; and a Bismarck at more than three score readjust the Powers of Europe, has naturally enough given up the notion that a seat by the chimneyside is the only place for the elders."

A SUGGESTIVE CASE OF NERVE-ANASTOMOSIS.

By Professor GEORGE T. LADD,
YALE UNIVERSITY.

SUCCESSFUL cases of the anastomosis of motor nerves presiding over different groups of muscles have been several times reported since 1897. Some of these cases have resulted in the transference of function between the flexor and the extensor nerves of the same extremity; in other cases, nerves serving so different purposes as the sympathetic and the pneumo-gastric have been successfully crossed. The anastomosis of mixed nerves offers, of course, a more complicated problem.

In 1898 Dr. Faure attempted to cure a case of facial paralysis due to destruction of the *Nervus facialis* by uniting its peripheral end with that portion of the *Nervus accessorius* which supplies the trapezius muscle. But in this case a satisfactory restoration of the function of the facial nerve was not secured. Still later experiments upon animals in Munk's laboratory, with a view to effect a functionally satisfactory anastomosis of the same two nerves, resulted in a partial success. And one instance of this particular operation in the case of a man, which was attended by a somewhat marked recovery of function, was communicated to the Royal Society by Dr. Kennedy, of Glasgow, in November, 1900. The same authority reported several instances of the same class of cases in the London *Lancet* for March 1, 1902. In one of these cases, Dr. Kennedy, operating "for facial spasm, divided the facial nerve and united it to the spinal accessory with the result that the face recovered its power of movement to a great extent, but that whenever the patient lifted the right arm a spasm of the face was produced."

The case of anastomosis, to which I wish now to call your attention, was performed by Dr. Harvey Cushing of Baltimore, in the spring of 1902; and it consisted in transferring the proximal stem of the divided accessory nerve *in toto* into the distal end of the injured and paralyzed facial. The injury to the facial nerve was in this case caused by a bullet wound which completely severed the nerve on the right side of the face; and it involved a loss of the sensations of sweet, sour and bitter substances over the anterior two thirds of the tongue on that side, and a total motor paralysis of the same side. The patient could not close his right eye; lachrymation and other discomforts of facial paralysis were present; and none of the muscles

responded either to the emotions or to the volitions which control them in their normal state.

The character of the anastomosis, surgically considered, will easily be seen from the charts (Fig. 1 and Fig. 2); and the unfortunate condition of the patient on making the effort to close his eyes is represented by the accompanying photograph (Fig. 3).

Dr. Cushing's surgery, so far as the completeness of the union effected between the two nerves was concerned, seems to have been unusually successful. This fact gives additional interest to the discussion of the results from the physiological and psychological points of view. At the time of the operation, owing to the healing of the injury done to the chorda tympani, the sense of taste had largely returned; but 'the patient's face had become, even during repose, much drawn to the left, and an effort to close the eyes would result in the peculiar grimace characteristic of facial paralysis, with tilting up of the eyeball,' as shown in the photograph (Fig. 3).

Almost immediately after the operation the patient insisted that his condition was improved; that he was no longer troubled with lachrymation, less troubled with saliva, and better able to dislodge food from his flaccid cheek. He also thought that some power of motion had returned to the eyelid. The doctor urges that this last symptom of improvement could only be due to the inhibitory action of the muscle concerned in raising the upper eyelid; the other 'subjective assurances of improvement' he confesses that he is at a loss to explain. About them it would seem we must say, either that the patient was altogether mistaken, or that at least some slight nervous impulse was already passing over the recently united nerve-tract?

On the tenth day after the operation the patient was sent home, provided with a small galvanic battery which he used for daily electrical treatment, and was later required to exercise the facial muscles persistently before a mirror. From this time on a fairly steady improvement was noticeable, beginning with the decrease in the asymmetrical appearance of the face while at rest, the lessening of the cleft between the eyelids; and ending with the more and more highly differentiated voluntary control of the facial muscles and even with the partial recovery of their response to the varied forms of emotional excitement. On the ninety-fifth day the patient reported that, while galvanizing the muscles and at the same time watching his face in a mirror, he noticed to his surprise, on moving his shoulder, that he could produce considerable contraction in the paralyzed muscles. As he expressed it: 'When I wish to laugh straight, I can help it out with my shoulder.'

A more particular description of this patient's condition at only two points of time subsequently will be quite sufficient for my purpose.

At the end of 168 days the asymmetry of his face when at rest was barely appreciable. He could to a slight extent dissociate movements of eye, nose and mouth. He could almost close his eye by voluntary effort. He could pronounce labials perfectly. He could pucker his lips, although not enough to whistle. He had considerable freedom of facial movement without lifting the arm or shrugging the shoulder. But "Elevation of arm and shrugging of shoulder still called forth general contraction of facial muscles which could not be controlled and which was sustained." The condition of the patient's facial muscles at rest is seen by the photograph taken at this time (Fig. 4). Another photograph (Fig. 5) shows the result of a volitional effort to contract the facial muscles, when aided by the arm elevated but completely at rest. At the end of 287 days the volitional control of individual groups of muscles had quite completely returned and could 'be effected without associated shoulder movements of contraction in the other facial muscles.' And although emotional expression had not improved to the same extent, it had returned in considerable measure. How involuntary contraction of the face was still produced by a sudden and vigorous elevation of the arm and shoulder is apparent from a photograph taken at this time (Fig. 6). But how, at the same date, symmetrical closure of the eyes was possible, without associated shoulder movements or the contraction of

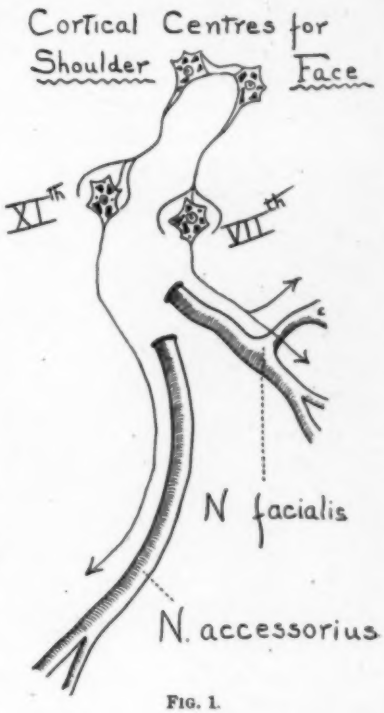

FIG. 1.

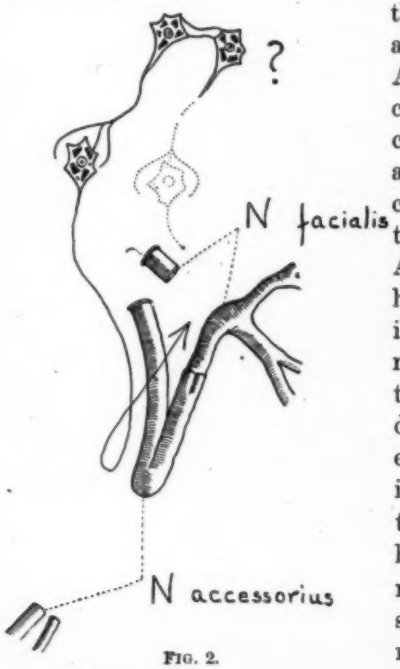

FIG. 2.

other facial muscles is seen illustrated in another photograph (Fig. 7).

A recent letter from Dr. Cushing summarizes the results obtained at this date, November 1904, by several similar operations in the

FIG. 3.

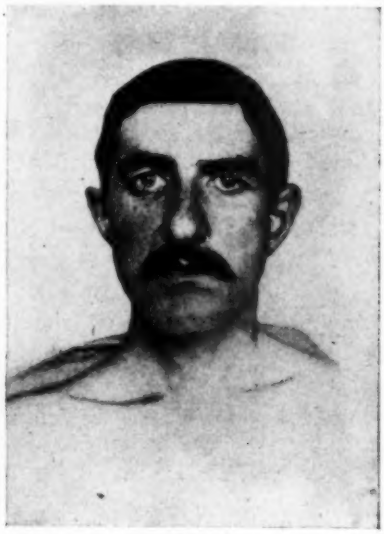

FIG. 4.

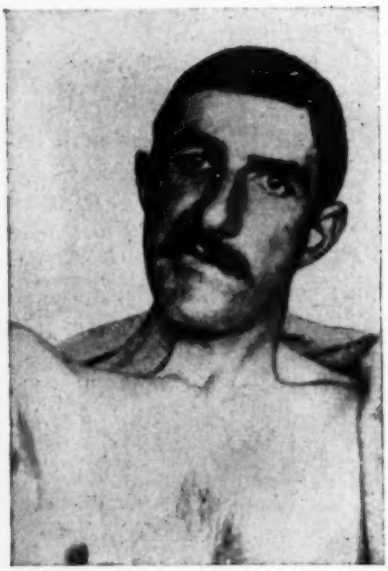

FIG. 5.

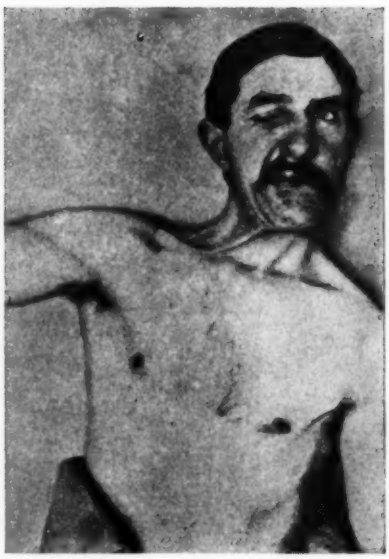

FIG. 6.

following words: "The first thing to return after the anastomosis is an involuntary movement of the face, associated partly with a volitional movement (shrugging the shoulder, for example) of the muscles

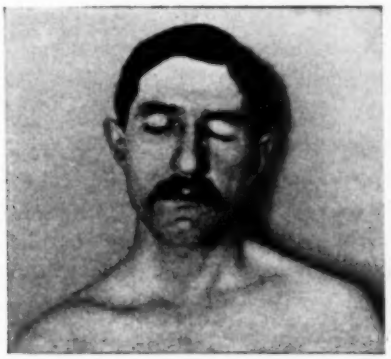

FIG. 7.

supplied properly by the spinal accessory. Following this in a few weeks there is some power of volitional movement in the paralyzed muscles of the face, without association of shoulder movements. Last of all comes—if it comes at all—the emotional movements over which the patient has no conscious volitional control."

This case which I have now presented in barest outline (and all similar cases of recovery of voluntary and emotional control of paralyzed muscles after anastomosis) raises a number of questions of interest to students both of cerebral physiology and of psychology from the physiological and experimental points of view. Among these the chief is, perhaps, the problem as to what takes place in the cortical centers that is brought about by the changes in the peripheral tracts through which the centers control the different groups of muscles. No completely satisfactory answer to this problem seems at present to be anywhere in sight. But there are three or four tenable hypotheses which may—probably with at least some factors taken from each—contribute toward the better understanding of the problem.

Of such hypotheses the first which I will mention suggests that a more or less nearly complete substitution of function took place between the center of the N. facialis and that of the N. accessorius. Their proximity would be favorable to this—the two centers being not more than about one inch apart. That the cortical center of the accessory nerve did exercise some control over the facial muscles through the united accessory and facial nerves is apparent from the effect produced upon those muscles by raising the arm or shrugging the shoulder. With the general fact of a certain power of substitution of new cerebral areas for disused or injured ones, cerebral physiology is familiar. But how centers so unlike in the character and variety of the muscular functions which they control as are the center for the facial muscles and the center for the trapezius muscle could substitute for each other, is difficult to imagine. Inasmuch, however, as the cortical

area, which was formerly 'accessory' in the control of the arm movements, evidently was accessory still in the control of the facial movements, as soon as the juncture of the new nerve-tract was complete; it is possible that the continued *exercise* of its functions by electrical and volitional stimulus developed the required variety and differentiation of function necessary for facial control. How the cortical center for the N. accessorius *knew* (*sic*) that it was called upon to come to the rescue and improve its discerning qualities, as a part of a more complex and intelligent motor system, may remain for us an unanswerable question.

In connection with this hypothesis we may perhaps help ourselves out with another. The fitting of hitherto unused nerve elements with the medullary sheaths necessary for their employment in voluntary motor functions would seem not to be an improbable assumption in the present case. The researches of Ballana, Stewart and others have shown that the regeneration of fibers in cut nerves is not, as was formerly supposed, effected by the growth of the proximal extremities of the axis-cylinders, but by axis-cylinders shot out from logitudinal cells which appear in the distal segment itself. Thus chains of cells are formed which fuse together and become invested with medullary sheaths. Flechsig has also shown that in the human infant at birth, while all the fibers of the spinal cord except those of the pyramidal tracts, which are used especially as conductors of voluntarily initiated impulses, have become myelinated, the vast multitude of fibers in the brain have not become so. According to Professor Sherrington, all this suggests a conclusion which has other evidence in its favor, namely, that a nerve-fiber is not a single nerve-cell process, but a series or chain of nerve-cells forming a functional continuum. The reason, then, why regenerated nerve-fibers do not attain maturity, and so perform their appropriate functions, unless they become united with the central end of some nerve, is that only by this union can they get an opportunity of actually performing these functions. That seems to amount to saying that the call upon them to perform unaccustomed work causes them to fit themselves for this work.

It is not, therefore, too violent an assumption to suppose that, in such a case of recovery of voluntary and emotional control of paralyzed muscles by anastomosis as I have narrated, a new cerebral apparatus of control may be called into use by the process of myelinating the necessary nerve-elements. Such a process might be relied upon either to equip the cortical center of the accessory nerve for its new and more varied functions of control, or to prepare new paths of connection between this center and that which had formerly exercised exclusive control of the muscles of the face through the facial nerve. In a word, the building process in the brain, finding much of the

old mechanism thrown out of its accustomed use, may have made ready another center and new tracts for the same use.

This hypothesis leads pretty directly to another which seems to be demanded by some of the facts of the case under examination. A more and more highly differentiated volitional control was obtained over the facial muscles; the stimulus of the various emotions, without the accompaniment of volition, met with a better response; and the sight of the condition of the facial muscles as afforded by a mirror was of help in gaining this increased control. All this experience would seem to prove beyond doubt that the higher cortical centers concerned in conscious volition, in emotion and in the perceptions of sight had somehow established the necessary new connections with the center, lower down, in control of the N. accessorius. In a word, whereas formerly, when the accessory nerve was only concerned in helping to lift the arm and shrug the shoulder, these volitional emotional, and visual centers, had paid little or no attention to their influence over the cortical center of this nerve, now that this center and this nerve were being called upon for unaccustomed and more elaborate functions, they found out a way to get into connection, and to bring the new apparatus under their control. But these volitional, emotional and visual centers are widely spread over the cortical area. About their special connections with one another, and especially with the center of the accessory nerve, under normal conditions, we are much in the dark. And how they could go to work to solve, in any length of time and even partially, the problem of readjusting their functional relations to the new and abnormal conditions, offers a problem as yet quite unanswerable by cerebral physiology.

There is one other assumption which would seem to be at once more simple, more sure, and more effective in explanation, than either of those hitherto made. What was the old cortical center for the control of the muscles of the face through the N. facialis doing all this time? We can scarcely suppose it to have been entirely idle or resting in indifference to the functions of which it had been so suddenly and rudely dispossessed. Indeed, it is as certain as anything about such matters can be that the cortical center of the facial nerve would not be allowed to rest. The fifth pair of nerves, whose function is to transmit the sensory impulses from the facial areas, was unimpaired; and since the discomfort from increased lachrymation, saliva and gathering food in the flaccid cheek was very great, this cortical center must have been perpetually sharply reminded of its neglect of duty. Moreover, every time the faradaic current was applied to the cheek, and the patient tried to get control over the facial muscles, helping himself meanwhile by looking in the mirror, there was undoubtedly a very excessive demand for activity made upon this now

powerless area from the other cortical areas, which were under excitement.

Now we know with certainty that increased intensity of the stimulation is followed by increased area of neural excitement. A spreading of the nervous processes on which the initiation of motor impulses depends—whatever the chemico-physical character of those processes may be—would, then, necessarily take place in the center of the N. facialis, in answer to the increased demands made upon it by the more intense stimulation from various higher areas. This spreading would, it is likely, have the double effect of enabling the center to use hitherto unused paths between itself and the center of the accessory nerve; and it might also compel the immature nerve-elements to myelinate themselves in preparation for the discharge of their new functions. When this enlarging area occupied, during its excitement, by the center of the facial nerve, had broken over, so to say, into the center of the accessory nerve, and had made good and useful the newly established connection between the two, then it could virtually resume its old functions of control, although now by a new and more roundabout path.

The assumptions previous to the last would all seem to be helpful, if not needful, to explain some of the features of this case of nerve-anastomosis and sequent recovery from facial paralysis. The last assumption is absolutely essential in order to make any satisfactory progress toward explaining it at all. The other assumptions very speedily bring us to the hitherto impenetrable veil of mystery which is met when any attempt is made to explain the facts of experience by our theories of cerebral physiology or of experimental and physiological psychology. But the last assumption seems somewhat to lengthen the distance to the veil. The picture of the unity in variety of the histological elements, and collections of elements, and of the physiological functions, which belong to the nervous system, offered by such experiences as that of this patient, assists in confirming the views arrived at experimentally by Professor Sherrington and other explorers in this field. But the unity and the variety of this infinitely complex system are not so much matters of wholly predetermined and, so to say, 'made-up' sort, dependent upon unchangeable histological peculiarities externally combined into a whole; they are, the rather, a growth, changeful, adaptable to varying conditions, dependent upon need and use, and conditioned chiefly, if not wholly, upon the possibility of establishing the necessary connections amongst the differently located elements.

Many of the more important and interesting problems of psychology are suggested by this case of anastomosis. No other group of muscles is so expressive, so responsive to ideas and emotions, as those which

are controlled normally by the facial nerve. To read the face is to read the soul, so far as the latter can express itself, or repress its expression, in any physical way. The whole history of this case reverses the normal history of the original development. Instead of the power of control being more and more acquired by experience of muscular and tactual sensations, and of the results produced by the external or emotional stimulation of these sensations, we have the increasing effect of the deliberate and persistent voluntary attempt to regain control, with its advancing degrees of success and increased differentiation; and last of all, and most imperfectly, the resumption of non-volitional motor functions under the stimulation of sensation and emotion. All this certainly looks like the picture of a mind learning how to use a tool, the construction of which has been suddenly so changed as to render it, for the time being, substantially a different tool. This, so far as the cerebral functions are concerned. The transmission of the motor impulses, when once started from the cortical centers, by new and unaccustomed tracts, is an affair of comparatively little significance either to physiology or to psychology.

In this psycho-physical progress, which I will call *the evolution of a more highly differentiated self-control,* all the various familiar forms of functioning, and laws of functioning, when seen from the psychological point of view, are apparent. The ease and ability increase with practise; the motor results are in a measure cumulative; the different forms of sensation-experiences inhibit or supplement and assist each other; and the effects of fatigue make themselves manifest. Such an evolution does not, however, seem explicable as *nothing more* than an increasing complexity, ease and precision of sensory-motor reflexes; although it has all the marks of dependence upon such a mechanical basis. To speak figuratively, what takes place in such cases of nerve anastomosis can not be completely and satisfactorily explained in terms that are applicable to a nervous mechanism, however complex, or complexly and mysteriously subject to improvements of a mechanical sort. An *agency,* that must be described in terms of ideation, apperception of an end to be attained, and purposeful volition consciously directed toward that end, seems also necessary to account for the whole result. If involuntary emotion and externally originated sensory-stimuli were the means of evoking and educating the motor organism, in the first instance; it is, on the other hand, conscious and purposeful voluntary effort which is the most important factor in the recovery of function and new education of the motor organism. And how astonishingly complex and even antecedently improbable, we might almost say, are the resulting histological and functional changes in the organism brought about by repeated volitions, our conjectural analysis of this case has suggested, if it has not made clear.

I am well aware that I shall be charged by some, both physiologists and psychologists, of harping again upon the same old string. But I confess that I am more and more indifferent to this charge. For I am more and more convinced that neither the idealistic nor the psycho-parallelistic theories of the relations of the nervous mechanism to the life of consciousness explain such a case of recovery from paralysis as this to which your attention has just been called. Indeed, both forms of theory seem to me to introduce a confusion, which increases rather than clears up, the fundamental mystery of the facts. To my thinking, nothing which can possibly be said as to why the mind has a body goes any way at all toward explaining how this patient got control of his paralyzed facial muscles, for purposes expressive of his emotions and his volitions, through the N. accessorius and its cortical center, after the direct connection by the N. facialis with its center had been totally destroyed. Nor does any explanation which could conceivably express itself in terms of psycho-physical parallelism seem much more satisfactory.

In a word, this suggestive case of anastomosis, and all similar cases, together with hundreds of other species of phenomena—some of them belonging to our ordinary experience and some of them due to extraordinary situations and developments—all seem to me to point unmistakably to the existence of *dynamical relations* between the nervous mechanism and the conscious mental life. And is not our science, whether we start from the physiological or from the psychological point of view, nothing but a description of this net-work of dynamical interrelations? But in being this, how is it any less scientific or any more essentially mysterious than is any other science? To all science, indeed, of every species, it is just these dynamical interrelations which are the ultimate facts. Behind them it is impossible for science to go. Every science consists in the discovery, classification and formulating under so-called 'laws' of these interrelations. To say *a priori* that that can not be, or is not, which most obviously is—this is to be essentially unscientific.

A VISIT TO LUTHER BURBANK.*

By Professor HUGO DE VRIES,
UNIVERSITY OF AMSTERDAM, HOLLAND.

FOR many years I had wished to make a study of fruit culture in California and especially of the production of new varieties. One reason which, more than others, made me decide to accept an invitation to visit California was the prospect of making the personal acquaintance of Luther Burbank.

Burbank is *the* man who creates all the novelties in horticulture, a work which every one can not do. It requires a great genius and an almost incredible capacity for work, together with a complete devotion to the purpose in view, to accomplish such results. Burbank possesses all these qualifications, and his previous achievements have excelled all expectations to such an extent that it is rightly presumed that no possible improvements are beyond his reach. In fact, the most impossible things are attributed to him, and the credulous American people expect from him novelties which any person who knows would immediately declare to be nonsense. I once had a conversation, in a Pullman car, with a lady and a gentleman who told me all kinds of interesting stories about plants and fruits, about climate and places and many other things. They knew, of course, Burbank. Every American does, who pretends to know anything about fruits. They told me all about the large and juicy plums, the new pears, the beautiful flowers, and a number of other creations of his. But by far the best and most delicious fruit, entirely new in form, color and flavor, was, they said, a hybrid between a raspberry and a mulberry! Over this mystic novelty her enthusiasm was inexhaustible!

As soon as I had decided about my plans I wrote to Burbank and told him my desire. I had previously been in correspondence with

* Authorized translation from the Dutch, by Dr. Pehr Olsson-Seffer, Stanford University. This article was written by Dr. H. de Vries, the eminent botanist and originator of the mutation-theory, while in California last summer. It was originally published in the magazine 'de Gids' in Holland, and forms a part of the third chapter of a book 'Naar Californië' by de Vries, which recently appeared in Amsterdam. It is of considerable interest to note the impressions de Vries, the scientific botanical experimenter, received during his first visit to Luther Burbank, the foremost practical plant-breeder in the world, whose remarkable achievements have created world-wide admiration, and to whom the Carnegie Institution recently granted an annual appropriation to insure the undisturbed continuation of his work for the next ten years.

him, and a few years ago I had hoped to meet him at the Congress of Hybridologists in London, but his arduous labors prevented him from being present. I feared even now that there would not be many chances of speaking to him, because July is his busiest time, when all the numberless crossings are made and the selection of prunes takes

LUTHER BURBANK.

place. These fruits at the present time are represented by a larger number of varieties than any other plant in his orchards. It is no small matter to select the best plum out of 300,000 different varieties. This requires not only talent and experience, but also a great deal of time, and it all has to be done within a few weeks while the prunes are ripe on the trees.

My wish to see him was, however, met with the greatest cordiality. Others had naturally the same desire, and we were consequently all invited to come together to Santa Rosa, where Burbank lives, and to inspect, under his personal guidance, his experimental plots. He set apart an evening and a whole day for our visit. How many crossings and selections he had to sacrifice for this I do not know. Our party was a rather large one. There was first Professor Svante Arrhenius—the man who with van't Hoff laid the foundation of modern physical chemistry. Among all the savants I ever had the fortune to meet, he certainly is the man with the widest knowledge and the broadest interests, and his opinion about Burbank's methods was of the greatest value to all of us. In our party was also the physiologist, Jacques Loeb, the discoverer of many important phenomena in regard to fertilization in lower animals. His studies have led him to the question of the causes of life and of those life-functions which give animals and plants their characteristics, expressed in the differences of kinds and varieties. These characteristics can not be studied to advantage except by means of hybridizing. So far no one in the whole world has made crossings on a larger scale than Burbank, and it was only natural that there should be many points in common between the studies of both these men. Our party was under the guidance of Professors Wickson and Osterhout, of the University of California. Both are personal friends of Burbank and, notwithstanding the distance, often visit him to keep posted on the progress of his work.

Americans, and especially Californians, feel a great deal of pride in their Burbank. He is a very modest man; he does not work for fame, or for honor, or for the acquisition of wealth. He has none of the aspirations of a merchant. He loves his plants, and is enthusiastic over his work and plans. To accomplish something great for his country is his ideal. For his personal self he is satisfied if his work furnishes him a living and enough to carry on his experiments.

In outward appearance Burbank is a very plain man, more a gardener than a savant, with clear blue sparkling eyes, full of life and fun, appreciating humor in others, telling us stories that kept us constantly laughing. He lives in a small house with his mother and sister, and has but one servant on the place, as he does most of the work personally. The walls of his room are covered with small photographs of his victories, and during our visit these pictures were taken down and demonstrated to us.

As a matter of course prunes interest him more than anything else. Of the hundreds of thousands, which he got by crossing, a few are already in the market. To give an idea of the interest connected with such a new kind I may only name the Waynard plum. This is a delicious, big and round, dark blue fruit with a taste that makes one think

of a peach. One seedling of this tree, the selection from hundreds of thousands, he sold to a company, formed especially for the purpose of multiplying and introducing it into the market. This company was not to raise crops from it and to sell the fruit, but to produce grafts

and as many plants as were required to introduce it into those states of North America where it will thrive, to make it one of the most commonly cultivated trees in the United States and thereby to add millions upon millions of dollars to the annual production of the country. How

much Burbank realized for this one seedling he did not mention to us, but it was certainly enough to compensate for his entire plum-culture of many years.

Such are Burbank's ideals. For himself it is sufficient to receive the cost of producing his creations. He has no children, and does not feel the necessity of accumulating money. The sole aim of all his labors is to make plants that will add to the general welfare of his fellow beings. Therefore he looks in his selecting for other qualities than those upon which we, in Europe, generally lay stress. 'Shipping qualities,' that is the ability to withstand handling in packing and shipping by railroads or vessels, are most important to him. Next comes the property that makes it possible to cultivate them in regions which previously have been unsuitable for this purpose. To produce varieties which combine with great productivity a sufficient degree of frost resistance is one of the chief aims of Burbank.

As an example of this, he spoke of his crossings with the Beach plum (*Prunus maritima*). Here and there along the coast, especially in the eastern states of North America, this shrub grows wild. It is satisfied with almost any conditions. The most infertile sandy soil is just as good as the richest loam; the driest place as agreeable as the temporarily inundated ground. On the eastern coast it thrives equally well in the north and in the south, being nowhere affected by the climate. It never suffers from frost, and always forms a dense shrub, often to the exclusion of all other tree-growth. In addition to all these qualities it is immensely prolific. It does not, of course, produce any edible plums; the fruit is of the size of a small cherry, with a large seed and a very thin layer of fruit-flesh. Late in the season the branches are bent down under the weight of the fruits, which cover the branches in great profusion. This plum has, further, a great number of varieties, with all kinds of forms and colors, some ripening in July and August, others as late as September or October. Even in taste there are differences. Although the fruit is uneatable, it is possible to judge about its flavor.

In many parts of California water is very scarce, but still the soil is fertile. In such regions the population is scanty and remains so, limited by the available water supply, in spite of the perfect climate and the fertility of the soil. Some kind of fruit tree that by means of long roots is able to get water from the deeper strata would be a blessing to such regions. Wealth and prosperity would increase and a large population could exist where lack of water now prevents cultivation. Burbank thinks he will be able to produce such a fruit tree by combining the deep-rooting tendency of the beach plum with the delicious flavor and richness of our common plums. He brought to his place all kinds of beach plum in order to cross them with other species.

His aim will not be accomplished by one crossing. Connecting links are required, and therefore the North American beach plum has to be crossed with other American and Japanese plums (*Prunus triflora* and *P. Americana*), and each of these hybrids with four or five kinds of the common plum. Finally a series of hybrids is developed from which almost anything can be expected.

It is natural that by such crossing we must expect the appearance of undesirable characters as well as desirable ones. Some plants produce only good, others only bad, characters, but the greater part exhibit some good points in connection with a larger or smaller number of undesirable qualities. From hundreds of thousands only those must be selected which possess all the desired characters. To make this possible it is necessary not only to cross six or eight kinds with one another, but to use as many sub-species and varieties as possible for the experiments. This work necessitates hundreds and even thousands of experiments. The result of each crossing can only be judged by the fruit, and this indicates new combinations. It can easily be seen what an immense amount of work, patience and capacity of judgment and choice is required to reach the ultimate aim. Yet Burbank told us on that remarkable evening of many such instances. He was enthusiastic in his hope to be able to realize all this during his life.

The making of hybrids from the different species of plums naturally brought us to a subject which, for me, was of the greatest importance from a scientific standpoint. As Arrhenius and Loeb also felt more interest in the theoretical side of these problems, I took the first opportunity to bring the conversation to that point.

I had in mind the 'pitless prune.' Just imagine this, reader! Next day Burbank took us to a plum tree heavily loaded with clear blue, very attractive, yet small plums. He picked a few and asked us to bite right through the middle of the fruit. We did as requested, and although we knew there was no stone in the plum, we experienced a feeling of wonder and astonishment. Inside the plum was a seed, like an almond in its shell, and with the taste of an almond, but without the stony covering. When cutting through the fruit, we found the seed surrounded by the green fruit-flesh, the innermost part of which was a jelly-like mass, in which could yet be seen some remnants of hard little stones, that scarcely offered any resistance to the knife. Burbank declared, however, that he was not at all satisfied with the result, and said that he had already young trees with fruits, in which nothing could be detected of the stone.

Osterhout told us about the impression this plum made on Professor Bailey, professor of agriculture at Cornell University. He came unprepared before this tree, and Burbank, always full of humor, thought it a good opportunity to play a little trick. Bailey had declared that

a stoneless plum was entirely an impossibility, something that was outside of one human lifetime; he refused to believe the statement and could not be induced to risk his teeth on the experiment. To the great amusement of Burbank and Osterhout, he took a knife from his pocket, commenced to peel the plum and to cut away the fleshy part, in order to expose the stone, which he was sure would be there. How great was his astonishment when he finally did not find anything but the naked eatable kernel!

A couple of years ago when I read in one of Burbank's price lists about a stoneless plum, I shared a similar astonishment. How was it possible to bring about such a great change? Hybrids do not present, as a rule, any new simple qualities, only new combinations of already existing properties. The evident properties are often developed from more than one factor, and such composite characters may thus appear, without any new essential factors having been present. This is a fundamental principle in crossing, whether it is done for scientific or for practical purposes. But although the elimination of the stone is only a loss and not a gain of a character, such a loss is just as much outside the sphere of hybrid making.

My astonishment was, therefore, as great as that of Bailey, and I had long ago made up my mind to ask Burbank, if I ever had the opportunity, what secret method or what happy coincidence had enabled him to effect such a fundamental change in a plant. I put my question to him that evening, convinced that on the answer depended largely the scientific value of our visit. And for the second time I was surprised over the unexpected and simple reply: "About two centuries ago they knew in France a 'prune sans noyau' and I bought the fruit and raised a plant in order to cross it with others of my prunes." Thus there is no exception to the rule, there has been no real production of a new character, but we have only had a case of the general American principle: 'try everything.' Over the whole world Burbank looks for different kinds and varieties of prunes, no matter how insignificant they may be, however wild and uneatable, as long as they possess only one or another characteristic, which, in combination with the common kinds, may bring out a new variety of greater value.

To Professor Loeb and myself this was, to a certain degree, a disappointment. We had expected to learn a great deal about this point, the fundamental idea, if not the ultimate aim, of the studies of both of us—that is, the question of the nature and origin of new characters. We now surmised that Burbank's experience did not throw any light on this question.

I had before experienced a similar disappointment. About twenty years ago I was occupied with experiments on hybridization for horticultural purposes. I had already found at that time the general

principle that only combinations, but no primary characteristics, were produced. Only in one instance I encountered what seemed to be an absolute exception to this rule. It was an announcement of Lemoine of Nancy, the most celebrated breeder of garden novelties in France. He claimed that he had been able to produce by crossing double lilacs. Double flowers remain longer on the branches than the single, which usually drop off after a few days. To find out how it was possible to develop by crossing from single lilacs new varieties with entirely new characteristics I visited Lemoine in Nancy. Walking through his gardens, I put the question to him and received the following answer: "That is very simple. As a boy I had seen in the garden of an old relative a specimen of *Syringa azurea,* a very rare lilac of an ancient type with double flowers. Remembering this, I bought that tree from the person who owned my relative's home. With this tree I crossed all varieties of single lilacs I had and got the double variety." Here we find again the same procedure: first buying, then crossing, later grafting or budding on other forms, but no creation of an absolutely new character. The number of combinations may be unlimited, yet the creation of new prime characters is entirely excluded.

This principle came into full evidence while we were in Burbank's grounds. He demonstrated to us 'white blackberries' with large fruit of a delicious flavor, which now are an article of commerce. I asked him about the origin of this crossing. Burbank explained that here and there in California occurred a wild blackberry with white fruit. He had crossed this plant with other forms. A white variety of the common raspberry has similarly been known in Eurpoe since olden times.

Another striking example is furnished by the spineless cactus, one of the novelties of which Burbank expects much. It is one of the Opuntias, a desert plant, the fruit of which is eaten and known as Indian figs. Its stem consists of big, flat slabs, joined together in the most fantastic manner. It reaches a height of six feet, spreading widely and growing luxuriantly. The fruit is much relished by cattle, as it is juicy, rich in foodstuff and has but few thorns. The whole plant is eaten by animals only when they are driven to do so by hunger, as it is covered with hard prickly thorns. If the plant is cooked for some time the thorns soften and the cactus becomes a nutritious food. This process of cooking is, however, too expensive for practical purposes, and hence a cactus without thorns would transform a barren desert into rich pastures. To reach this Burbank brought together wild Opuntias from Mexico, South Africa and various other countries as well as the commonly cultivated species. Among the specimens Burbank received, one was accidentally found without prickles on the leaves and another with no thorns on the young shoots. It was, there-

fore, necessary to combine in one plant both these negative characteristics, something that experience has shown can be done. However easily this is explained, still it elicits astonishment and wonder to see a cactus without spines. All that is now left to be done is the crossing with forms known as the most nutritious, and at the same time to watch the development of other characteristics, especially the root system. It will not take many years for Burbank's cactus to transform large stretches of desert into fertile fields even without irrigation.

Along the road in front of Burbank's house is a long row of high trees with wide spreading crowns and dark foliage. These are Burbank's first hybrids, walnuts, that are a combination of the eatable nut and an ornamental tree of the same genus (*Juglans regia nigra*). From seeds of this hybrid Burbank raised a few rows of seedlings which show a surprising variety in growth and leaves. These latter are all lanceolate, sometimes with broad leaflets, sometimes with narrow, some are petiolate, others sessile on the branchlets, now coarse and then fine, frequently reminding one of the common English walnut, and again approaching the ancestor, the black walnut. We saw some of the variety of forms resulting from crossing, and from these the best have to be selected for certain purposes.

Burbank's entire garden contains only two and a half acres, while the experiment farm near Sebastopol, about one hour's drive from Santa Rosa, comprises twenty acres. Two days each week Burbank spends on the farm, riding there on his bicycle; the rest of the week he is at home. Here are all the more delicate crossings, and it is here every new experiment is started. It is only when certain definite results are in view and when the cultivation of thousands of specimens is required that they are raised on the farm near Sebastopol.

He showed us a bed of wild flowers in his garden. He collects these in the vicinity, transplants them, selects and crosses the various forms as soon as they promise anything of advantage. Others he crosses with cultivated species of sufficient relationship. His idea in doing this is to make a large number of garden plants, which will be so fertile, and consequently so cheap as to come within the reach of any one. Briefly, he wants to spread over every garden spot in California a still richer treasure of flowers than it already possesses. Thus, for instance, he has crossed the large and deliciously night-scented *Nicotiana affinis* with the wild, tree-like *Nicotiana glauca,* which can not be called an ornamental plant on account of its greenish flowers, but by flowering profusely and by having such large bunches of flowers, it offers an excellent object for hybridization. We noticed several kinds of Cape gooseberries (*Physalis*), of the blood-red *Heucheras* and others already hybridized. The common garden poppy (*Papaver somniferum*) he had

crossed with the large flowered, brilliant orange-red, perennial poppy, and a great number of hybrids were now growing. These were almost all sterile. Some of them terminated in a dried-up stub without flowers, others had a minute rudiment of fruit, others only remnants of calyx and corolla. There were all stages up to normal flowers, and seed capsules in which the not yet fully developed seeds could be seen through a lens.

After crossing all kinds of color varieties of the common poppy he got one with a light blue color. Although the color is not very pretty, yet this plant is very interesting, as blue poppies have been hitherto unknown. Probably the change in color is caused by the combination of pigments in some flowers and the chemical constituents of cells of others. This is, however, only a supposition.*

Many other wild plants, as *Brodiæas, Erysimums* and *Cephalyptrum Drummondi,* he had hybridized, getting flowers which first came out carmine red, but then slowly changed to white, a very unusual mode of variation. In order to reduce the price of *Amaryllis* and *Gladiolus* to a few cents, and thus make these beautiful red and white-striped flowers common in every garden, he devoted attention to the increase of side-bulbs. He had already plants with twenty to twenty-four bulbs instead of the old forms with hardly any or but a few side-bulbs. Burbank has his own peculiar ideas about the power of nature and natural phenomena, which play such an important part in his work. His principal theory is that 'heredity is the sum of all past environments.' This he repeated time and again in his explanations. Crossing brings together in one individual the sum total of the environmental influences to which the two lines of parents have been subjected, and hence increases its variability.

Among the remarkable results of Burbank's work which we saw at the Sebastopol farm were a couple of trees of Loquat (*Eryobotrya japonica*) about six feet high, but with spreading fruit-laden branches. One of these trees was the original Japanese kind with small yellow fruit, the size of a cherry, of acid taste and almost filled with the large seed. It has a peculiar flavor, found in no other fruit. This aroma was also found in the fruits of the other tree, but these were larger than walnuts and had an orange-red color. The seed was not larger than that of the wild tree, but the juicy fruit-flesh was greatly developed in thickness and very delicious. This improvement of the loquat, which fruit makes one of the finest delicacies for the table, was accomplished by Burbank without crossing, by selection only. This is the same process by which, since the time of the celebrated Belgian horti-

* The original reads: De kleur berust waarschijnlijk op een verbinding van de kleurstof van sommige soorten met de scheikundige inhoudstoffen van de cellen van andere. Maar voorloopig is dit nog slechts een vermoeden.

culturist, Van Mons, our large and juicy apples and pears have been produced, that is, by sowing the seed on a large scale and then continuing the selection for one or more generations. About one half of Burbank's grounds was taken up by prunes. He has at present about three hundred thousand different kinds. The number of trees is not so great, however, as he grafts his seedlings on other trees, when they are two or three years old and show some promise for the future. For this purpose he uses the whole seedling, throwing away the roots. We saw small trees with from thirty to forty grafts, and large ones upon which two hundred to four hundred branches were grafted. When the foliage is of different color and form and the branches bear plums, red, yellow or blue, flat or round, small or large, some ripe and others only half developed, the result is strikingly bizarre. When the fruit is ripe he walks along the rows, marking those which are undoubtedly the best, as far as can be judged by a cursory examination. Then a workingman removes all those which for one reason or another are considered valueless. By this method only about half of his original stock is left, and this then receives his careful investigation. Possessed of an inborn talent, he is able to select in a few summers four or five of the best kinds among the hundreds of thousands on his grounds. These are then multiplied, while all the others are destroyed and replaced on the mother trees by the next series of seedlings. These are often somewhat assorted even before transplanting from the shallow boxes where they have been grown. Sometimes the color of the leaves indicates the value of a tree, as in crossings between the common cherries and prunes with *Prunus Pissardi,* which, on account of its brown foliage, often is cultivated as an ornamental tree. In other cases the size of the leaf is an indication of certain properties of the fruit, Burbank's long experience enabling him to see some correlation between leaf and fruit. Thus he can with some certainty discard a number of trees before transplanting, which naturally saves time and room.

One of Burbank's favorites is a large 'Marguerite,' which he calls the 'Shasta Daisy,' after the great California mountain of that name. It is one of his improvements of a perennial daisy which grows wild in Shasta county, and is very variable. By crossing and selecting, it has been developed into a plant that excels by its rapid growth and its profusion of extremely large beautiful flowers, which for months cover the ground. These and other characteristics will make the Shasta daisy one of the commonest and cheapest, still one of the most beautiful, of garden plants.

What makes Burbank's work entirely different from that of other plant breeders is the immense scale on which his selecting is made. He is, therefore, able to make greater improvements than others and in much shorter time. In his work Burbank is guided by a special gift

of judgment, in which he excels all his contemporaries. The best proof of this is to be found in the great success his creations have made, not only in North America, but also in Europe.

His methods of work are the same as those followed by plant breeders in Europe. Secrets he has none, and if he is not willing to demonstrate his cultures to everybody, this must be attributed to the fact that his time is too valuable. There is no fear that any one could 'steal his trade' by merely looking at it. Every one is left free to follow in his path, but without the special disposition for it nobody will succeed, and for simple imitation the entire process is too complicated.

To give an idea of the immensity of his cultures, it is sufficient to cite one instance. When selecting a new kind of blackberry he picked out the best from 60,000 specimens, all in full bearing, dug up the rest and burned them. This is his way of working, not only with one kind of fruit or flower, but with all. The most remarkable trait, however, of his work is that he experiments with as many forms as possible. This method is carried to the highest degree of perfection, and thereby his results are so stupendous that they receive the admiration of the whole world.

However large may be the number of forms subjected to crossing and selecting, this method is in itself limited. Burbank's products are all, with a few exceptions, reproduced not from seed, but by vegetative propagation. Grafts or cuttings, bulbs, shoots or division of roots are the means of multiplication. It is well known that vegetative propagation results in much greater stability than raising from seeds, which often produces degenerate types. Because of this fact, Burbank hardly ever experiments on annual or biennial plants, but confines himself to perennials.

In Burbank's methods selection plays the most important part. To accomplish a good selection, however, the greatest possible degree of variation is a prerequisite. This variation is attained mainly through selection of the starting points and through artificial hybridization. The results are next cultivated on a large scale under environmental conditions which will develop as many differences as possible.

Varieties coming from separate localities differ not only in regard to external characteristics, but their capacity of modification varies considerably, and can often be ascertained only in the special environments of an experimental garden. The greater this power of adaptation the more chances for the experimenter.

As a general rule, it holds true that the results of crossing depend primarily on the selection of varieties used for that purpose. These indicate, so to say, the program, the list of possibilities from which the choice and the combinations have later to be made. Outside of this

list very little good is obtained, and then only by accident. This occurs very seldom in Burbank's cultures.

When he wishes to experiment with wild flowers Burbank goes out himself in search of specimens. He carefully compares the different places of growth and investigates the variation in individuals. Many days are thus employed in gathering together one kind in order to find out existing dissimilarities or to see whether they promise anything for future cultivation. Such specimens are then transferred to his experimental grounds, and when established are subjected to crossing.

With crossing or hybridization we usually understand the sexual union of two individuals belonging to different species or varieties. In practical plant breeding, however, it is not sufficient to combine two types, but three, four, and even five or six kinds are thus united, so as to bring out as many desirable qualities as possible in one single variety. It is, of course, impossible to predict what result will be obtained, and it must be left to chance and the future to decide what combinations are the most desirable. Often crossings are made only with the object in view that among all the combinations something good may turn up. In this case the breeder wants to destroy the equilibrium of existing characters, to make the constant forms unstable, and then to select the best out of the many balancing properties. When the parents themselves are variable their offspring will naturally be more so, and the number of differences increases with the number of hybrids experimented upon.

There is also a chance that latent or sleeping characters may be brought to light. From a scientific point of view we know, as yet, nothing about this, but Burbank holds the opinion that in many cases one character prevents another from becoming visible. For instance, in crossing, the first one meets an opponent which has kept it back—as is often the case in the crossing of varieties—and this latent character gets an opportunity of becoming active. We can naturally not detect what dormant qualities are hidden in a plant, and may, therefore, expect all kinds of surprises. The combinations may be desirable, and the hybrids can be propagated immediately, or they may be the reverse and need further crossing before the unfavorable traits are eliminated. Unknown atavistic properties may in this way become evident and may play an important part in the development of future generations.

In other cases the crossings are made with a certain purpose in view. These are the instances from which we learn the most, and which at the same time give the best chances for quick and favorable results. A certain number is selected of species or varieties, which together contain those characters we want combined in one type; the undesirable properties we try to eliminate. As the crossings result in all kinds of combinations, it is necessary to produce them in

as large numbers as possible, so that among the numberless undesirable and imperfect plants we may choose the best. The chances are that from the five or six desired good characters only three or four are found together. Thousands of seedlings have to be developed in order to create a possibility of finding one form in which the expected qualities are present. It is a game of solitaire on a large scale. I may mention as an example of this the production of the Alhambra plum, which was obtained by combining European, American and Japanese kinds. It took thirteen years to combine all these. First came the crossing of the Kelsey with the *Prunus Pissardi.* Their hybrid was crossed with French prunes. In the meantime various other crossings were created, and it was made possible to work the pollen of these 'into the strain,' as the term is called. First came *Simoni* × *triflora,* and then *Americana* × *nigra.* This sevenfold combination gave us the variety now known in the market as the Alhambra.

We can go still further and cross species that are yet more widely separated. It is then naturally even more difficult to predict the results. Burbank endeavored to combine the plum and the apricot and succeeded in getting a new fruit, which he calls plumcot, of very delicious taste and looking very much like an apricot, but combining the soft skin of this fruit with the dark color of the plum. Burbank had a number of varieties of this new fruit, some with a yellow fruit-flesh, others of dark red color, light rose or white. In taste these plumcots differ considerably.

Burbank is equally successful in hybridizing flowers. In the instance of the *Callas*—well known through the many varieties of *Richardia aethiopica*—all the new cultivated forms have been hybrids of a few species. Burbank, however, crossed *Calla hastata,* the yellow 'Pride of Congo,' *C. Elliottiana* with dark yellow flowers and spotted leaves, *C. Pentlandi,* also yellow with dark purple spots, the rose-colored *C. Rehmanni,* and the small light yellow *C. Nelsoni.* From all these he received a great number of different hybrids, among which were found the most varying shades of color, very large-sized as well as dwarfish forms. The colors were not limited to spadix and spathe, but spread over peduncles and petioles, and even the leaves were variegated with spots and stripes. In addition to these peculiar colors and forms the hybrid *Callas,* of which Burbank had long rows in bloom at the time of our visit, possess a hardiness and adaptability to extreme temperatures, which fit them for outdoor cultivation, where formerly *Callas* could be forced to full development only in hothouses. Every year these hybrids are again subjected to the process of crossing, and each year new and often unexpected forms appear. How far this will go it is at present impossible to predict.

Because of the favorable climatic conditions under which Burbank

conducts his experiments, he is able to work on a much greater scale than is possible in Europe. While we can only select from a few hundred of seedlings, Burbank can get tens of thousands into blossom. In this way the number of years necessary to bring about improvements can be considerably reduced. It required in Europe more than half a century to produce the beautiful *Amaryllis* forms, which we admire so much. Burbank has got wonderful results in much shorter time. In the process of selecting he preferred those forms which required the shortest time to come into blossoms, and by following up this method he succeeded in greatly shortening the duration of life from seed to seed, as it is called. It is evident what this means. Instead of having to wait four or five years after a crossing, before the result could be judged by the flowers, Burbank can make his selection in half the time. This, of course, not only includes saving of time, but also reduces the size of the cultures, and consequently the expenses. Burbank's aim is to make *Amaryllis* one of the most common ornamental garden plants, which will find its place in parks and private residences, in city gardens as well as near the farmer's humble dwelling. In order to introduce new forms into the stock of *Amaryllis,* Burbank endeavored to cross them with the related *Crinums,* and, from what we saw, his first trial was crowned with success. From the Florida swamps he obtained a wild *Crinum Americanum,* which has proved its fitness for crossing, and at the same time he had in his hothouse varieties from tropical regions, which he was going to cross with more hardy forms, so that they would feel at home in the California climate.

Among all the above mentioned points upon which I desired to draw special attention is the shortening of life from seed to seed. As the experiments, with a few exceptions, are conducted on perennials, and as vegetative propagation only is resorted to for multiplication, it would in many cases necessarily take several years before the plants flowered. Where repeated crossings have to be made this would cause considerable difficulty.

The means which make it possible to shorten the vegetative period are three: first, the splendid climate of California; second, the selection of the earliest flowering seedlings, and, finally, the method of grafting. Experience has taught us that the best way of forcing the stem or branches of seedlings to an early development is by grafting them on older trees. On a good-sized plum tree may be grafted, as said before, hundreds of seedlings. They will bloom in a couple of years, and as soon as they bear fruit selections can be made. The inferior grafts are then removed, so as to allow room for the good ones to develop more rapidly.

In the process of artificial crossing the greatest possible precautions have to be taken in the application of pollen. Yet the method is as

simple as possible, because the hybridization is carried on on such a large scale. First the stamens of the flowers to be crossed have to be removed. This is usually done while the flower is in bud and the stamens close together. One circular cut only is sufficient. Care must, of course, be exercised so as not to hurt the pistil. Next protection against insects has to be provided for, as otherwise pollen might be transferred from other flowers and the expected results spoiled. In scientific experiments a great deal of attention is paid to this, and the flowers are carefully enclosed in cases of metal gauze or in especially prepared paper bags, so that no insects can reach them. In practical plant breeding this would, however, be too cumbersome. By the circular cut mentioned not only are the stamens cut through, but the corolla is also removed, and the flowers are consequently not so conspicuous and do not attract the insects, except where there is fragrance. The majority of Burbank's improved fruit trees belong to the first category. In practical work the visit of a single insect is not so much feared, because all the mischief it may do in bringing the pollen is to produce a valueless hybrid. This can later be destroyed. Besides, the insect may come too late to bring about any result. But there is also a possibility that a new and good hybrid may be produced. The application of any cover is, therefore, entirely out of the question. This is the reason why unexpected results of such practical work are never entirely free from the suspicion that they are due to accidental introduction of pollen. Such results, therefore, do not enable one to draw reliable scientific conclusions.

Burbank's method is to collect the pollen required for these crossings on watch-glasses, as it keeps fresh for about a week. With these glasses he goes to the plants he wants to pollinate and applies with his finger tip a little of the pollen on the stigma. This is, as a rule, not yet ripe, but the pollen adheres to it until it matures. Fecundation thus begins at the time the stigma becomes glutinous, which lessens the possibility of other pollen being introduced.

I wish now to consider one of the most remarkable features of Burbank's work, the immense scale upon which it is conducted. This is the best plan for obtaining the most variations in a short time. He starts thousands of seedlings for each hybrid, and when the culture admits and the interest requires it, this number is increased to 50,000 or 60,000. In order to give an idea of the significance of these figures and of the work they imply, Burbank shows in one of his catalogues an autodafé of hybrid raspberries and blackberries. For the purpose of getting a hybrid with larger berries and bigger bunches he cultivated 65,000 seedlings until they blossomed and were in full bearing. A few dozens were selected, and the balance, heavily loaded with fruit, were dug up and gathered in a pile, which was then reduced to ashes. And

this goes on every year; fourteen or fifteen such bonfires a year are not uncommon. One consisting of 10,000 to 15,000 roses, luxuriantly flowering seedlings, annihilated the work of a number of years after the selection of only three good varieties. Half a million lily bulbs were entirely destroyed after fifty of the best had been separated for further cultivation. And so I could cite a number of instances.

It is evident that the chance of finding something good is much greater if the selection can be made from hundreds of thousands instead of from a few hundred only. Those who wish to compete with Burbank will have to accept this principle, and if this can not be done, they had better follow a different method and select species that admit the use of different methods.

It is theoretically of great interest to compare Burbank's principle with the methods of selecting generally in vogue in Europe. There the work is not performed on such a large scale. Preference is given to repeated selections, and the idea is prevalent that the desired results can be reached only by following the regular road. The question is whether by such repeated selection we proceed faster than by a single sowing on a larger scale. We can easily calculate the proportion, and it can be said that with five years' work a hundred times smaller number of plants have to be cultivated. This would, of course, lessen the expenses in proportion, but there is always the disadvantage of the result being available so much later.

When novelties are wanted in varieties of *Begonias, Geraniums, Dahlias* or *Fuchsias,* for instance, which annually produce many new forms, the hastening process would be of no value, but in new genera unexpected results are often attained, and in that case the hastening method will amply repay the expense. Yet these questions are the secrets of breeders. Of scientific importance is the question whether repeated selections are alone sufficient to bring about the same end, and further if by this means more variations are produced.

We have no facts which would decide this, and I would not have brought up the question, had it not been for its great influence on the study of evolution. It is closely connected with the question whether species slowly merge into one another or whether they originate by mutations. In the former case small deviations would increase in the course of generations, and thus a long series of intermediate forms would connect the new and the old species. In the latter case a jump is made without any intermediate stages. So long as there were not sufficient instances of this mode of change, and so long as we had to rely upon cultivated varieties only as proof, the first proposition was naturally the most probable. It rested on experience in agriculture and horticulture in regard to improvements of races, and it was believed that species in nature originated in the same manner. The re-

sult of breeding on such a large scale as that mentioned above was at the time unknown, and it was believed that the results could be obtained only by repeated selections. If by experiments on a large scale the varieties could be produced at once, the former view would evidently lose much of its value.

The magnitude of Burbank's work excels anything that was ever done before, even by large firms in the course of generations. The number of fruits and flowers which he has improved is unequaled. Others confine themselves to one or two genera; he takes hold of everything. The majority of breeders who became famous by their improvements of certain groups took up this work merely as an adjunct, as a means of widening their commercial relations, thus creating a greater demand for their nursery products. Burbank commenced in the same way, but as soon as he had obtained what he thought he required, the nursery business was abandoned, and he devoted himself exclusively to the improvement of flowers and fruit. It is to this resolution he owes his present fame.

Another point of importance which is also evident from Burbank's work is that in many genera the development of hybrids seems to have reached its limit. In some cases neither Burbank nor any other breeder could produce something new. Apples, pears, peaches, strawberries and a few other types are quite exhausted. The circumference of their form-circle, if I may be allowed to express myself this way, or, as Americans say, their possibilities, are already taken up in cultivation. Inside that circle, of course, improvements are possible, and every one who eats canned apples, or pears, or peaches from California knows that progress in regard to these fruits is evident enough. But Burbank himself considers those species exhausted, and he asks for his improvements no higher rank than what already exists. He has added to them only greater productivity and the qualities required for packing and shipping. It is, however, by just these qualities that a great deal of California's prosperity has been created and the fruit export to Europe increased, qualities which the consumer applauds as much as the European orchardists fear them.

From a scientific point of view Burbank's varieties are but individual, by which I mean that the variety has been produced by one single individual, hence from one seed. That specimen has then been multiplied by vegetative propagation into the thousands, or probably millions, of plants which are in the market. As an individual the variety preserves the characters obtained through hybridizing.

Exceptions to this rule are rare. Burbank has, however, obtained a few hybrids which are stable when raised from seeds. These are naturally crossings of stable species or at least stable hybrids. As an example I may mention the hybrid between the California dewberry

and the Siberian raspberry. Both have small and insignificant fruits, while the hybrid on this point greatly surpasses either parent. In Europe we have long known similar instances through the studies of wild hybrids by Kerner, and by Wichura, Janzewsky and many other writers regarding cultivated bastards.

If the relationship between species is not close enough, all attempts to hybridize are frustrated. Either the crossing is a failure, and no seeds are produced, or hybrids are obtained which are infertile. In the case of flowers this is not of so much importance, but in regard to fruit trees such a result is a complete failure. It is evident that nature has here drawn a limit which man can not cross. This boundary line is, however, not marked, and consequently once in a while surprising results are obtained. Hybrids which are infertile in thousands of cases may for once prove a success among hundreds of thousands. Burbank has an example of this in his crossing of *Petunia* with tobacco. From numberless hybrids he got one germinating from seed. He named this curiosity *Nicotunia* (from *Nicotiana* and *Petunia*). It was not very attractive and succumbed after one year, having flowered profusely, but failed to produce any seed.

It is unfortunate that we can not see this limit of nature in advance, but have to learn it by experience. And this experience includes an almost incomprehensible amount of labor of which no one hears anything.

SOME PHASES OF THE EDUCATIONAL PROBLEMS IN CHINA.

By WALTER NGON FONG,

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IN dealing with any part of the educational problem, it is necessary for us first to define our field. In this paper we shall consider the subject from the standpoint of one endeavoring to introduce 'western' learning among the Chinese. The fact that the Chinese do want to adopt western ideas and learning does not facilitate the task of regenerating the Chinese mind to as great a degree as the casual observer might suppose. While the present conditions are, of course, much more favorable for the introduction of new things into the Chinese life than they were a few years ago, still innumerable obstacles and difficulties remain in the path of one who wishes to be of some real assistance to the 'Coming New China.'

The ignorance of the students' parents and relatives or guardians is one of the most formidable enemies of modern education in southern China. As soon as the student reaches the age of sixteen or seventeen his parents get him a wife. We might think that a student who can get a wife without bothering his head over the affair has the advantage of saving the time which would be spent by a European or an American in courting. Still, to assume the responsibilities of married life at the age when he is just able to begin higher studies will prove an almost insurmountable barrier to the advance of the average student. Perhaps he is furnished with enough money to go to school, yet his wife must have some 'pin money,' and as she does not like to ask her father-in-law for every cent she needs, she soon begins to make demands upon her husband's slender purse.

As the Chinese 'gentleman youth' is not trained to do anything, he can not earn any money by doing 'odd jobs' while in school. Therefore, he embraces the first opportunity to obtain a position of some sort and leaves school. His school career is now ended forever and his desire for higher learning gradually becomes extinguished.

Very few Chinese realize that a useful education must be thorough and that to obtain a thorough education requires time. While they are willing to permit their boys to be crammed with obsolete classics for fifteen or twenty years with the hope of becoming Mandarins, yet they are not willing to let them study six or eight years in a modern

institution of learning. All that they want their sons to obtain is a knowledge 'sufficient for the need.' By this expression they mean that as soon as their sons are able to take positions as clerks, their education is 'finished.' Their highest ambition is to have their sons become chief clerks or compradores in commercial houses, thus insuring comfortable livelihoods.

Even the students who aim higher than 'business English' are anxious to find a short cut to learning and to obtain a general knowledge of science, philosophy or law in a very brief period. They are not willing to spend weeks, if need be, on a single point. They have no desire for original investigation; no craving for research work; no yearning to become wise above 'that which is written.' They are not willing to sacrifice time, pleasure and money and make everything subservient to the one aim of getting a thorough education.

Filial piety, inculcated into them by generations of usage and enforced upon them by their parents, is another great drawback. For instance, if a paternal relative is indisposed, the student must leave school and travel to his village to pay his respects to the sick one, thereby losing from a week to ten days' schooling. In the event of the marriage of a relative or of any other important festivity, the parents desire that the student be excused for another ten days or so, thus breaking into the continuity of his studies.

The poor physical condition of most of the students is another hindrance to their progress, and necessitates many days of absence from classes. Having been accustomed under the old Chinese system of education to commit to memory what was written, many of the students, who enter an institution of foreign learning where they are required not to memorize but to reason out the cause and effect and to give explanation for all that they do, find the work very hard upon them physically. Their ability to think and reason has been dwarfed by their previous training, and the transitional period of their mental readjustment is a great strain upon their weakened constitutions. One might ask, 'How have their constitutions become weakened?' By the use of tobacco and by the conditions under which they have studied. In the Chinese schools they have sat at their books from dawn until dark and read far into the night, seven days a week almost the whole year round, without physical exercise or proper ventilation. Consequently, the physical condition of many of the most diligent students is most deplorable.

Western education in China, like many pioneer undertakings elsewhere, has not had a proper start. Until recent years, very few real educators have come to China to establish schools. Formerly, most of the schools in which western learning was taught were conducted by zealous missionaries; unfortunately, most of the missionaries were not

trained educators. Educational institutions are expensive and even the missionaries who were skilled in the art of teaching had no money for the necessary equipment.

The main reason why no teachers of high standing, who could hold professorships in any of the reputable colleges at home, have been working in China is the lack of money and facilities to induce them to come. When a scholar leaves civilization to go to regions far from home he must see some advantage in going. If he can go with a financial gain or library and laboratory advantages, he is willing to sacrifice the comforts and conveniences of the homeland. But China did not have the money to pay for high-salaried teachers or to provide any library or laboratory inducements for the scholar.

Nowadays we hear much of the colleges of western learning which the Chinese government proposes to establish in all parts of the empire. This calls to mind another difficulty, viz., the inability of the Chinese to manage a school properly. Most of the Chinese who try to start institutions of learning have no idea what a foreign college looks like. They have no means of knowing how to select men; neither are they capable of knowing whether the teachers whom they employ know how to give instruction. Formerly they thought that any foreigner could teach any or all of the subjects constituting 'western' learning. There were always plenty of unscrupulous foreigners willing to take advantage of the ignorance of the Chinese regarding educational affairs and to pose as 'professors' of anything or everything for the sake of the salaries. There were also numerous equally unscrupulous Chinese, who, having obtained a smattering of English in some foreign land, returned to China and undertook to give instruction in many branches.

Experience with such impostors has taught the Chinese to be suspicious of everybody and everything concerning western learning. We can not blame them for this. Confused by such experiences and reinforced by their profound ignorance of modern education, the Chinese school managers are exceedingly difficult to 'handle.' Notwithstanding their good intentions, they really do not know what they intend to do. As a result, the instructors whom they employ have to spend a large portion of their energy in managing the 'school-managers,' instead of being free to devote all of their attention to their school work proper.

Most of the schools in China, present as well as past, have big names only, regulations by the volume and curricula which exist only on paper. With their characteristic power in imitation and their time-honored conservatism, the Chinese school trustees want to follow this or that school instead of leaving the instructors free to administer the affairs of each school in accordance with its own peculiar needs.

What China needs to-day is not so much the higher theoretical

education as some real, practical training. Her people are not ready for the former, but are badly in need of the latter. The first utility of education should be to enable those educated to earn a competency, without which we can hardly expect a man to go about discussing the nice points in law or in science, while a starving family awaits him at home and an empty stomach gnaws within. With her countless millions of population, China has no workmen skilled in the production of any part of the furnishings for the comforts and conveniences of modern life. To-day China is using modern conveniences and appliances that she can not produce. This being the condition, practical manual training in the useful arts is her first necessity. If China wishes to become a member of the great family of civilized nations, she must be educated out of the idea that an educated gentleman should not perform any manual labor, and that learning and labor are divorced from each other.

Though our path is thus strewn with difficulties and obstacles, yet we as educators do not labor without a bright ray of hope. The Chinese mind has all the elements of a good soil for the implantation of the seeds of learning; it only needs proper cultivation. For example, there are in the Li Shing Scientific and Industrial College at Hong Kong, young men and boys who, five months ago, had no idea of what science was, who can now perform chemical experiments understandingly and discuss many scientific topics intelligently. Once having tasted the flavor of the new learning, some of the students try to devour the subjects with the eagerness of a starving dog that sees a piece of meat. When they are interested in their studies, they apply themselves to their books with all the force of mind and body. This better class of students is very orderly, docile, impressionable and respectful.

Although at first many of the students are slow to comprehend the methods and aims of a system of education so new to them, my experience has been that after a few months some of those who were apparently indifferent suddenly take hold as if by inspiration. Having become interested, nothing can woo them from their books, and, instead of having to hold them to strict account for their daily work, we have to keep them back. I have in mind, in particular, one fourteen-year-old boy who, when he entered our school, was a very idle and playful scholar. He was so idle and unruly that he had to be kept standing by the teacher's desk the greater part of the time. Indeed, we had our doubts whether it was best to allow him to remain with us. After a few weeks his reasoning powers became unearthed and he took an absorbing interest in chemistry. From that time forth there was no further occasion for reprimand; there was a marked changed in all his work and his progress in English was very rapid. His ability to apply what he learns, his power to grasp new ideas and his faculty for

asking pointed questions are marvelous; it takes a well informed, wide-awake teacher to cope with him. He is but one of the many for whom the modern institutions of learning recently established in China are throwing open the doors of true knowledge.

When the Chinese youths have caught the student-spirit which dominates our western colleges, they become real 'digs,' and not even their physical weakness can deter them. Therefore, we have reason to hope that when their constitutions shall have been strengthened by the abstemious life, the hygienic surroundings and the physical exercises which are features of the new institutions, China will have students able to sit at the banquet of learning with those of foreign nations.

The field being so great, the educators should not try to rival each other, but should rather endeavor to cooperate, in order to facilitate the enlightenment of this vast empire of the east. We can not at present expect to have real universities, where each institution shall have all the departments; therefore, the existing colleges should aim to supplement each other, each trying to establish some thoroughly equipped, special departments that the others do not have.

Colleges established in China need strong men, who are not afraid of hard work or of difficulties, and who will not worry if they attract but few students; men who will endeavor to carry on their respective institutions on a modern educational basis, and who will form plans and policies suited to the demands of the time and place. Thus manned, colleges in China will be able to send forth graduates educated in the true sense of the word and fitted to be useful in society. These college-trained men will act as a leaven which in time will change the whole social fabric of Chinese life, thus removing many of the obstacles which now confront the educator. In this way, existing colleges will advertise themselves by the quality of their graduates much more effectively than by any amount of pomp and show; will serve as models worthy of imitation; and will solve many of the present problems.

THE SOCIAL PHASE OF AGRICULTURAL EDUCATION.*

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I HAVE been asked to speak in behalf of the study of 'Rural Economics.' This term is, I presume, supposed to cover broadly those subjects which treat of the economic and social questions that concern farming and farmers. The whole range of social science as applied to rural conditions is thus apparently made legitimate territory for discussion. In view of the importance and character of this field of study, it seems wise to approach it if possible through the avenue of its underlying philosophy. Only in this way can the validity of the subject be established and its place in agricultural education be justified. I have, therefore, chosen as a specific title, 'The Social Phase of Agricultural Education.' In the treatment of the topic an endeavor has been made to hold consistently in mind the point of view of the agricultural college.

It is a principle in social science that the method and scope of any social institution depend upon its function. Therefore the organization, the methods and the courses of the agricultural college should be made with reference to the function of the college. What is this function? What is the college designed to accomplish? What is its social purpose? Why does society need the agricultural college? Answers to these questions are of two kinds, those that explain the contemporary and passing functions of the college, and those that illustrate its permanent and abiding service to society and particularly to the rural portion of society. The college of yesterday was obliged to train its own teachers and experimenters; to-day it may add the task of training farm superintendents; to-morrow it may organize an adequate extension department. Courses and methods will change as new contemporary needs arise. But there remains always the abiding, final service of the agricultural college, its permanent function. This function will be defined in different ways by different men, but I venture to define it as follows: *The permanent function of the agricultural college is to serve as a social organ or agency of first importance in helping to solve all phases of the rural problem.* We shall not attempt at once to argue this proposition. We must, however, try to answer the question, What

* Read November 2, at the eighteenth annual convention of the Association of American Agricultural Colleges and Experiment Stations, Des Moines, Iowa.

is the rural problem? And in the answer may be revealed, without need of extended discussion, the mission of the college.

1. The days are going by when agriculture may be classed with the mining industries. Soil culture is supplanting pioneer farming. Skill is taking the place of empiricism. The despotism of the grandfather is passing. Applied science and business practise have been hitched to the plow. Yet the most obvious need of American agriculture is better farming. Improved farm land in the United States gives but nine dollars of gross return per acre; the average yield per acre of corn is 23.5 bushels, whereas a very modest ideal would be double this amount; the wheat yield is 13.5 bushels per acre, in Germany nearly twice as much. These are crude but legitimate illustrations of our inferior farming. We must have greater yields of better products, secured at less cost per unit. The farm problem is, therefore, first of all a problem of increasing the technical skill of our farmers. Science unlocks the cabinet of nature's treasures, but only the artist-farmer can appreciate and use the storehouse thus opened to him.

2. But produce-growing is not the only aspect of the farm problem. Each effective pair of shears needs two blades; in this case produce-selling is the other blade. Mere productiveness does not solve the farm question. The farmer cares less for the second spear of grass than he does for a proper return from the first spear. Business skill must be added to better farming methods. The farm problem is also a business question.

3. The moment, however, we begin to discuss price we enter a realm where economic factors dominate. We commonly say demand and supply determine price; but effective demand and effective supply are the resultants of many forces. The supply of a given product is influenced by the cost of growing in various locations, by cost of transportation, by competition of other countries. The demand is influenced by the state of wages, by standards of living, by effectiveness of distribution. The farmer may not always control these conditions, but he must reckon with them. He must know the laws of economics as well as the laws of soil-fertility. The farm problem becomes then an industrial question; for the farmer's prosperity is influenced most profoundly by the economic life of the nation and of the world. And in a still wider sense is the rural question one of economics. The industry as a whole must prosper. It is of no great moment that here and there a farmer succeeds. The farming *class* must prosper. Of course individual success in the case of a sufficient number of farmers implies the success of the industry. But it is quite possible to have a stagnant industry alongside numerous individual successes. The farmers as a whole must be continually and speedily advancing to better economic conditions.

4. Nor may we ignore the political factor in the rural problem. Doubtless the American farmer, like most Americans, places undue reliance upon legislation. But we can not disregard the profound industrial and social effects of either wise or foolish laws. The political efficiency of the farmer will have much to do in determining class progress. Furthermore, the political duties of farmers must be enforced, their influence must continue to be exerted in behalf of the general policies of government. It is of vital consequence to our democratic government that the American farmer shall in no wise lose his political instinct and effectiveness.

5. The consideration of the political phase of the question leads us to the heart of the farm problem. For it is conceivable that the farmers of this country may as a class be skilled growers of produce, successful sellers of what they grow, and indeed that the industry as a whole may be prosperous, and yet the farming class in its general social and intellectual power fail to keep pace with other classes. It is not impossible that a landlord-and-tenant system, or even a peasant system, should yield fairly satisfactory industrial conditions. But who for a moment would expect either system to develop the political and general social efficiency that American democratic ideals demand? Even if there is no immediate danger of either of these systems becoming established in America, we still desire that our farmers as a class shall secure for themselves the highest possible position not only in industry but in the political and social organization of American society. Indeed this is the ultimate American rural problem, *to maintain the best possible status of the farming class.* No other statement of the problem is satisfactory in theory. None other is explanatory of the struggles and ambitions of farmers themselves. The American farmer will be satisfied with nothing less than securing for his class the highest possible class efficiency and largest class influence, industrially, politically, socially. It is true that industrial success is necessary to political and social power. But it is also true that social agencies are needed in order to develop in our American farmers the requisite technical skill, business method and industrial efficiency. The influence of such social forces as education, developed means of communication, the organization of farmers, and even the church, must be invoked before we can expect the best agricultural advancement. And the end is after all a social one. The maintenance of class status is that end.

This analysis of the rural problem is necessarily brief, almost crude, but I hope that it reveals in some degree the scope and nature of the problem; that it indicates that the farm question is not one merely of technique, fundamental as technical skill must be; that it demonstrates that the problem is also one of profound economic, political and social significance. If this be so, do we need to argue the proposition that

the function of the agricultural college is to help solve all phases of the problem? We all recognize the place of the college in assisting our farmers to greater technical skill. By what pleas shall we gainsay the mission of the college in ministering to rural betterment at all points, whether the conditions demand technical skill, business acumen, industrial prosperity, political power or general social elevation? Why shall not the agricultural college be all things to all farmers?

Assuming that this statement of the permanent mission of the agricultural college is an acceptable one, the practical inquiry arises, does the college as now organized adequately fulfil its function, and, if not, by what means can the defect be remedied? The colleges are doubtless serving the industrial and social need to some degree. But I believe that it is not unjust to assert that the existing courses of study in agriculture, the organization of the college and the methods of work are not adequate if the college is to secure and maintain this supreme leadership all along the line of rural endeavor. This is not criticism of existing methods. The colleges are doing good work. But the present effort is partial, because the emphasis is placed upon the technical and especially upon the individual phases of the problem. The industrial, the political and the social factors are not given due consideration. Our present-day agricultural course, on the vocational side, is chiefly concerned with teaching the future individual farmer how to apply the principles of science to the art of farming, and in training specialists who shall make further discoveries either in the realm of science or in the application of the scientific principle to the art. The technical element absolutely dominates the vocational portion of the agricultural course. Very slight attention is given to the discussion of other phases of the farm problem. To meet the needs of the future the whole spirit and method of the agricultural college must be 'socialized'—to use an overworked phrase for want of a better one. We must get away from the idea that the individual and the technical aspects of agricultural research and teaching are the sufficient solution of the farm problem.

When we ask, what are the means for 'socializing' the agricultural college, the expected answer may be, the study of rural social science or 'rural economy.' But I am pleading not merely for the addition of a few subjects to the course of study, but for an educational policy. The answer, therefore, will not be quite so simple. What then are the methods by which the college may more fully assume its function of helping to solve all phases of the farm problem?

1. The indispensable requirement is that the college shall consciously purpose to stand as sponsor for the whole rural problem. It is to assume a place of leadership in the campaign for rural betterment. Whether or not it is to be the commander-in-chief of the armies of

rural progress, it should be the inspiration, the guide, the stimulator of all possible endeavors to improve farm and farmer. This attitude of mind is purely a matter of ideals, deliberately formed in the light of the abiding needs of the farming class. It is the intangible but pervasive influence of an object which is perfectly definite even if avowedly spiritual. It is a question of atmosphere. It is a matter of insight. The college must have a vision of the rural problem in its entirety and in its relations. At the college we should find, if anywhere, the capacity to understand the ultimate question in agriculture. We know that this ultimate question in agriculture can not be expressed alone by the terms nitrogen, or balanced ration, or cost per bushel, but must be written also in terms of the human problem, the problem of the men and women of the farm. So we shall see the college consciously endeavoring to make of itself a center where these men and women of the farm shall find light and inspiration and guidance in all the aspects of their struggle for a better livelihood and a broader life. The college must avow its intention of becoming all things to all farmers. Whether this means the study of fertility, of animal nutrition, of soil bacteriology, or whether it means the consideration of markets, of land laws, of transportation, of the country church, of pure government, the college will lead the way to the truth.

2. As the first requisite is that of the conscious ideal or purpose, the second is one of organization. It seems to me that the socialization of the college can not proceed very far until the principle of university extension is pretty fully recognized. The college must be in constant and vital touch with the farmers and their associations. Therefore each agricultural college should as rapidly as possible develop a definite tri-partite organization which reveals the college in its threefold function as an organ of research, as an educator of students, and as a distributor of information to those who can not come to the college. These are really coordinate functions and should be so recognized. The college should unify them into one comprehensive scheme. The principle of such unity is perfectly clear; for we have in research the quest for truth, in the education of students the incarnation of truth, and in extension work the democratization of truth. Until these three lines of effort are somewhat definitely recognized and organized, the college can not work as leader in solving the rural problem.

3. Thirdly, the social sciences, in their relation to the rural problem particularly, must receive a consideration commensurate with the importance of the industrial, the political and the social phases of the farm question. In research, for instance, the colleges should make a study of the history and status of these aspects of agriculture. As a matter of fact, we know very little of these things. There have been but few scientific investigations of the economic features of the industry,

and practically nothing has been done in the more purely social questions. Here is a great untilled field. How the various farm industries have developed, a comprehensive study of the agricultural market, the relation of transportation to the industry, the tendencies as to centralization of farms and tenant-farming, the sociological questions of rural illiteracy, pauperism, insanity, health, education, the effects of rural life upon character, religious life in the country—a hundred subjects of importance in the solution of the farm problem are almost virgin soil for the scientific investigator. It is the business of the agricultural colleges to assist, if not to lead, in such work of research. It is work that must be done before the social phases of agricultural education can be fully developed.

When we come to the course of study, we face a question difficult for some colleges because the agricultural curriculum is already overcrowded. I have not time to discuss this practical administrative question. I believe, however, that it can be worked out. What I wish to emphasize is the idea that in every agricultural course the social problems of the farmers shall have due attention. We should not permit a person to graduate in such a course unless he has made a fairly adequate study of the history and status of agriculture, of the governmental problems that have special bearing upon agricultural progress, of such questions in agricultural economics as markets, transportation, business cooperation, and of such phases of rural sociology as farmers' organizations, the country church, rural and agricultural education, and the conditions and movements of the rural population. For the college can not carry out the purpose we have ascribed to it, unless these subjects are given an important place in the course of study. We talk about the work of the college in training leaders, usually meaning by leaders men who are expert specialists or possibly farmers of extraordinary skill. Do we realize that the greatest need of American agriculture to-day is its need of *social leadership?* Nothing can be more imperative than that the agricultural college shall send out to the farms both men and women who have not only the capacity to win business success, but who also have the social vision, who are moved to be of service to the farm community, and who have the training which will enable them to take intelligent leadership in institute, school, church, grange, and in all movements for rural progress. Upon the college is thrust the responsibility of training men and women to understand the whole rural problem and from the vantage ground of successful farming to be able to lead the way toward a higher status for all farmers.

Possibly the argument for introducing rural social science into the agricultural course is chiefly a sociological one. But there is also involved a pedagogical question of most profound significance. For sev-

eral decades the educational camp has been sharply divided over the ancient but recurring controversy between the Greek cultural ideal and the Roman utilitarian ideal. I venture the opinion that these two forces of educational idealism will soon reach a compromise which for all practical purposes will take this question out of the pale of serious debate. The classicist will concede that the scope of the term culture may be greatly enlarged, and he may even allow a quite new definition of the cultivated man. It will be generally admitted, to use Professor Bailey's phrase, that 'every subject in which men are interested can be put into pedagogic form and be a means of training the mind.' On the other hand, the technical educator will concede that a college graduate, in whatever course, should be a cultivated man and that there are certain studies with which all cultivated men should have some familiarity. The technical college will, moreover, be compelled to employ instructors who can so teach the technical subject that it shall not only give the knowledge and training desired, but shall also yield sound culture, become truly liberalizing and vision-giving. But a greater question remains. As society becomes more fully self-directive, the demand for social leadership increases. Almost instinctively we look to the college-trained man for such leadership. We expect him to understand and to help answer the questions that society has to meet. It is not enough that he do his particular work well; he has a public duty. Only thus can he pay all his debt to society for the training he has had. Yet to-day our technical courses are largely engaged in training individuals who, barring some general culture, are highly specialized experts. What preparation, for instance, does the future engineer get in college for facing such a matter as the labor question? He is likely to be brought into close touch with this question. But as a rule he is not especially qualified to handle it. The point of view of the course he has pursued is technique, ever technique. He secures in college little incentive and less training for intelligent performance of his duty as citizen and as member of society. The problems of mathematics are not the problems of industry, and profound study of chemistry gives neither the premises nor the data for sound judgment upon social questions. These public questions can not be left to social experts. A democratic society must insist that all its educated men shall be leaders in solving society's problems. But even the educated men can not lead unless they have first been taught. I believe society has more to fear from technical experts who either neglect their social duty or are ignorant of the social problem than it has from highly trained specialists who have never studied Greek nor mastered Browning. Moreover, under modern conditions, have we a right to call that man cultivated who ignores the great social problems of the age? We face here one of the coming educational questions, how can the industrial course be

made to train men for the social leadership the new régime demands? I see no answer except that the course must be made truly and broadly vocational, and consequently that large place must be given to social studies, and particularly to the concrete problems of government, industry and social life.

If we examine our agricultural course from this standpoint, we shall have to admit that it has the flaw common to most industrial courses. It is too technical. It is not truly vocational. It does not present the social view-point. It does not stimulate the student to social activity. It does not give him a foundation for intelligent social service when he shall go to the farm. He should study agricultural economics and rural sociology, both because rural society needs leaders and because, in the arming of the man, the knowledge of society's problems is just as vital as either expert information or personal culture.

4. To carry out the function of the agricultural college we need, finally, a vast enlargement of extension work among farmers. This work will not only be dignified by a standing in the college coordinate with research and the teaching of students, but it will rank as a distinct department, with a faculty of men whose chief business is to teach the people who can not come to the college. This department should manage farmers' institutes, carry on cooperative experiments, give demonstrations in new methods, conduct courses of reading, offer series of extension lectures, assist the schools in developing agricultural instruction, direct the work of rural young people's clubs, edit and distribute such compilations of practical information as now appear under the guise of experiment station bulletins, and eventually relieve the station of the bulk of its correspondence. Such a department will be prepared to incorporate into its work the economic, governmental and social problems of agriculture. It will give the farmers light upon taxation as well as upon tree-pruning. The rural school will have as much attention as corn-breeding. The subject of the market—the 'distributive half of farming,' as John M. Stahl calls it—will be given as much discussion as the subjects bearing upon production. We shall find here a most fertile field for work. The farmers are ready for this step. They have, as a rule, appreciated the real nature of the farm problem more fully than have our agricultural educators. Perhaps at times they have placed undue reliance upon legislation. Perhaps in periods of depression they have overweighed the economic pressure as against the lack of skilled farming. But the great body of farmers has rightly estimated the importance of the economic, political and social questions as related to their ultimate prosperity. In grange meetings, for example, the subjects which arouse greatest interest are such themes as taxation, the rural telephone, the country school, business cooperation. The explanation of all the farmers' movements is that the farmers be-

lieve the farm problem to be much more than a question of technique. They want light on the whole problem.

The college, chiefly through its socialized extension department, has a mission also to those professional people whose sphere of work is in the rural community. The rural educator, the country clergyman, the editor of the country paper, and even the lawyer and physician who deal with country people, should have a large share in helping to solve the farm problem. They, too, need to know what the rural problem is. They, too, need the eye that sees the necessary conditions of rural betterment and the heart that desires to help in rural progress. By some of the same methods that reach the farmers themselves can the college instruct and inspire these others.

And, finally, the college will take its place as the 'social organ or agency of first importance in helping to solve the farm problem in all its phases.' The church, the school, the farmers' organization—all these social organs have their work to do. None can do the work of the others. But they should work together. Each should appreciate its own mission and its own limitations; each should recognize the function of the others, and all should intelligently unite their forces in a grand campaign for rural betterment. More properly than perhaps any other agency the socialized extension department of the agricultural college can act as mediator and unifier, serve as the clearing-house and directing spirit in a genuine federation of rural social forces. Inspired by the conscious purpose of the college to help at all points in the solution of the farm question, informed by the knowledge acquired through research into the economic and social problems of agriculture, aided by a multitude of educated farmers trained in the colleges to know the rural problem and to lend a hand in its settlement, dignified by its status as a coordinate branch of the college activities, the extension department may well act as the chief agency of stimulation and unification in the social movements for rural advancement.

In this discussion the practical details of carrying out the program advocated have not been touched upon. When once it becomes a distinct policy of the college to assume leadership in the movement for rural betterment, such questions as subject-matter for study, text-books, qualified instructors and time in the curriculum will settle themselves. Neither has any attempt been made to give illustrations; and, therefore, this paper may seem dogmatic if not academic, a prophecy rather than an outline of progress, the statement of an idea rather than a practicable program. But I think there is abundant evidence that a current is setting in toward the enlargement of the work of the agricultural college, along the social lines indicated. The rapid development of farmers' institutes, the growth of other phases of extension teaching, the sentiment of those in authority that the experiment station must

soon slough off its work of education and confine itself to research, the holding of occasional conferences for rural progress, in which country teachers and pastors join with the farmers, the initiative of the college in federating various state farmers' organizations into one grand committee, the inauguration of several brief courses in agricultural economics and rural sociology, the cooperation of some of the colleges with the Carnegie Institution in an investigation into the history and conditions of agriculture in its economic and social phases, the pride with which a few of our colleges point to the increasing number of young men they are sending to the farms—all these facts seem clearly to indicate that the agricultural college will soon assert its function of leader in the endeavor to solve all phases of the rural problem.

If the analysis thus offered is a correct one, the question of 'rural economics' is far from being merely a matter of adding three or four subjects of study to the agricultural course. It involves the very function and policy of the college itself. It alone gives proportion to the problem of agricultural education, because, while distinctly admitting the need of better farming and the consequently fundamental necessity of the technical training of farmers, it emphasizes the importance of the economic and political and social aspects of rural development. And it thereby indicates that only by a due recognition of these factors, in purpose, in organization, and in course of study, can the American agricultural college fulfil its mission to the American farmer.

EDUCATION FOR EFFICIENCY.*

By Dr. W. H. MAXWELL,
SUPERINTENDENT OF SCHOOLS OF THE CITY OF NEW YORK.

THE National Educational Association meets in its forty-fourth annual convention at the moment when Japan has given the world another great object lesson in the value of education. Ever since Napoleon's retreat from Moscow, the world has stood in awe of that massive and mysterious power which we call Russia. In that fateful campaign it was not the skill of the Russian commanders or the bravery of the Russian soldiers that wrought the catastrophe; it was the snowflakes—the arrows from the quiver of God—that overwhelmed the might of the invader. Ever since, Russia has gloried in a victory that was not of her own achieving. The world accepted her at her own valuation, and stood in awe. Wrapt in the glamor of an unearned renown, Russia pursued her aggressions practically unopposed, until her empire stretched from the Baltic Sea to the Pacific Ocean. There her career of conquest has ended. There, once again, has broken out the irrepressible conflict between ignorance and enlightenment. On the one side stand a people, almost countless in number and rich beyond knowledge in all natural wealth, but ignorant, devoid of initiative, and alienated from their rulers by despotism and cruelty. On the other side stand the Japanese, a people limited in numbers and confined in territory, but born again through the diffusion of knowledge and through the universal training for efficiency which has made their inherited patriotism invincible.

Japan has but repeated at Port Arthur and at Mukden and on the Yellow Sea the lesson of history—the lesson of Marathon, of Zama, of the Invincible Armada, of the Heights of Abraham, of Waterloo, and of Sedan—the lesson that the race which gives its children the most effective training for life, sooner or later becomes a dominant race. Borrowing eagerly from western civilizations, Japan has adopted for her own whatever school exercise or method of teaching gives promise of training for efficiency. Nobly has she repaid her debt to Europe and America. She has demonstrated to the world that the training of the young to skill of hand, to accuracy of vision, to high physical development, to scientific knowledge, to accurate reasoning and to practical patriotism—for these are the staples of Japanese education—is the best and cheapest defense of nations.

* Address of the President of the National Educational Association, Asbury Park and Ocean Grove, July 3, 1905.

Such are the lessons of war. The history of peaceful industrial effort tells the same story. No nation is truly prosperous until every man has become not merely a consumer but a producer. As Emerson most truly said: A man fails to make his place good in the world, unless he not only pays his debt, but also adds something to the common wealth. Efficient universal education that makes men producers as well as consumers is the surest guarantee of progress in the arts of peace—is the mother of national prosperity.

'But,' exclaims an objector, 'this is gross materialism.' Not so. The history of the world shows that a nation improves morally and intellectually only as its physical condition is strengthened. The futility of religious missionary effort, when unaccompanied by physical betterment, is of itself sufficient to prove the thesis. Better shelter, better food, better clothing, are the necessary antecedents and accompaniments of higher thinking, greater self-respect and more resolute independence.

True, material prosperity too often brings with it a train of evils all its own; sensual indulgence or slothful ease, it may be; or the grasping at monopoly and 'man's inhumanity to man'; or a feverish pursuit of material things to the neglect of the spiritual. True, enormous wealth is often accompanied, particularly in crowded centers of population, by extreme poverty. These, however, are but temporary reversions to barbarism—the price we must pay for progress. The best correctives of the evils generated by the accumulation of wealth are not anti-trust laws or other repressive legislation, but a system of schools which provides a training for all that is equal to the best which money can buy; which discovers and reveals genius born in low estate and enables it to fructify for the common good; and which guarantees to every child the full development of all his powers. The trained man will demand and will, in the long run, receive his due share. Education is a chief cause of wealth and the most certain corrective of its abuse. In a community in which every man was trained to his highest efficiency, monopoly and poverty would be alike impossible.

In the light of these historic truths you will permit me, as a prelude to the addresses that are to be delivered before the meetings, general and departmental, of this convention, to state very briefly—I do not venture to say, discuss—a few of the burning educational questions of the day.

The first of these questions is: What does education for efficiency mean? It does not mean that every man should be trained to be a soldier. True, the man who is well trained for the duties of peace is, in these days of scientific instruments of destruction, well prepared for war; but military prowess can never become the ideal of education among a great industrial people. It does not mean merely that each citizen should be able to read the newspapers and magazines so that

he may be familiar with political discussions and able to make an intelligent choice between candidates and policies. The imparting of such knowledge to each individual is essential in a democratic nation, but it falls far short of the education needed to secure the highest efficiency of each unit of society. Still less does it mean that wretched travesty of education which would confine the work of the public schools to those exercises in reading, writing and ciphering which will enable a boy or a girl at the age of fourteen or earlier, to earn starvation wages in a store or factory. Education for efficiency means all of these things, but it means much more. It means the development of each citizen first as an individual and second as a member of society. It means bodies kept fit for service by appropriate exercise. It means that each student shall be taught to use his hands deftly, to observe accurately, to reason justly, to express himself clearly. It means that he shall learn 'to live cleanly, happily and helpfully, with those around him'; that he shall learn to cooperate with his fellows for far-reaching and far-distant ends; that he shall learn the everlasting truth of the words uttered nearly two thousand years ago: 'No man liveth to himself' and 'Bear ye one another's burdens.' Such, I take it, is the goal of American education.

If this ideal of developing the highest individual and social efficiency of each citizen is the goal of American education, obviously the curriculum of our schools becomes an object of extreme solicitude. Particularly is this the case with the elementary schools, for these contain over ninety per cent. of the children under instruction. During the last quarter of a century a great movement for the reform of the elementary curriculum has been gathering strength. The most prominent characteristics of this movement would seem to be the development of the imagination and the higher emotions through literature, and art, and music; the training of the body and the executive powers of the mind through physical training, play and manual training; and the introduction of the child to the sources of material wealth, through the direct study of nature and of processes of manufacture. At first the movement seems to have been founded on a psychological basis. To-day the tendency is to seek a sociological foundation—to adjust the child to his environment of man and of nature.

At various times during the past ten or fifteen years, and particularly during the past year, reactionary voices have been loudly raised against the new education, and in favor of the old. Such was to be expected. Reactions follow inevitably in the wake of every reform, political and social. Analysis will show that the reactionary tendencies in education arise from three chief sources:

1. The demagogic contentions of selfish politicians who see that it costs more money to teach the new subjects of the curriculum than the old, and that thus a large proportion of the public revenue is diverted

from the field of political spoils. These are the men who have invented the term 'fads and frills' to designate art, manual training, music and nature study. It must be theirs to learn that it will require something more than a stupid alliteration to stem the tide of those irresistible forces that are making the modern school the faithful counterpart of the modern world and an adequate preparation for its activities. The saving common-sense of the common people, when deliberately appealed to, will always come to the rescue of the schools.

2. The reactionary tendency is due in part to an extremely conservative element that still exists among the teaching force. For the most part, teachers who are extremely conservative were themselves brought up chiefly on the dry husks of a formal curriculum. They find it difficult to learn and to teach the new subjects. They dislike to be bothered by the assistance of special teachers. Accustomed to mass work both in learning and in teaching, they regret the introduction into the school-room of arts which demand attention to individual pupils.

3. The reactionary tendency has its roots even among the more progressive teachers in a vague feeling of disappointment and regret that manual training, correlation and nature study have probably not accomplished all that their enthusiastic advocates promised ten to twenty years ago.

The feeling of disappointment, we might say even of discontent, among the more thoughtful and progressive teachers, is what might have been anticipated. In the first place, public education has become a much more difficult thing than it was half a century ago. It has become more difficult for two reasons:

1. Because of the constantly increasing migration of population from the country to the cities. Children removed from rustic to urban life lose that most valuable education which comes from the work and the associations of the farm-yard and the fields.

2. Because of the enormous increase in immigration from abroad, and particularly because the character of the immigration has changed. Up to the middle of the last century the majority of our immigrants were of kindred blood with the American people and a large proportion spoke our language. Gradually, however, the tide of immigration, while swelling until it has now reached the enormous total of one million a year, has shifted its chief sources from the shores of the North and the Baltic Seas to the shores of the Mediterranean. The peoples of southern Europe, illiterate, accustomed to tyranny, without individual initiative, and habituated to a low standard of living, huddle themselves together in our large cities and factory towns under conditions inimical alike to morals, to physical well-being and to intellectual advancement. Teachers have a good right to complain that municipal authorities in permitting the over-crowding of immi-

grants in unsanitary quarters have aided the establishment of the most serious obstacle yet discovered to the upward progress of public education.

In the second place, the feeling of disappointment with the results of the newer studies arises from the fact that these studies were introduced before the teachers were prepared to teach them; that for too long they were concerned chiefly with uninteresting formal processes rather than with interesting results; that they were not related to real needs of school and home; and were not properly coordinated with other phases of the curriculum. Much yet remains to be done to assimilate the environment of the school to the environment of the world.

And yet, while we may feel discontented with the situation, and regret the increased difficulties of our work, there is no reason for discouragement. I have no hesitation in saying that in general intelligence, in all-round efficiency, in power of initiative, the pupils whom I see are superior to those of a quarter of a century ago. If the obstacles before us are more formidable, if the problems are more complicated than those presented to our predecessors, the teachers of America are better organized and better equipped to overcome the obstacles and to solve the problems. He who has sailed in a modern steamship through an ocean storm has seen the mighty vessel cleave the billows and scarcely slacken her speed in the teeth of the hurricane. Down in the depths of the ship men are piling coal on the furnaces and releasing a force—the imprisoned sun-power of uncounted ages—that baffles the waves and defies the whirlwind. And so it is with our ship of state. Come what storms of ignorance or wickedness there may, teachers are supplying the fuel of knowledge and releasing the force of intelligence that will hold our nation in the straight course of progress.

And yet, the teachers of America are still far from satisfied with their achievements. They are dissatisfied with the elementary curriculum, because it seems crowded by the new studies that have been added without diminishing the number of the old. They are dissatisfied with the high school curriculum because the old-style language, mathematics and science course, however suitable it may be for admission to college, does not precisely meet the needs of boys and girls who are going directly into life. They are dissatisfied with the specialized high school, because it seems lacking in some of those attributes of culture in which the old time school was strong. And they are dissatisfied with the college course, because the elective system which has taken the place of the old, prescribed course does not seem to give a strong, intellectual fiber to the weaker students who, too often, follow the path of least resistance. And they are dissatisfied because there is less intelligence, less efficiency and less helpfulness in

the world than the world needs. So far from feeling concerned at this widespread discontent, we should rejoice that it exists. There is nothing so blighting to educational enthusiasm as smug satisfaction with what is or what has been; there is nothing so stimulating to educational effort as a realizing sense of present imperfections and of higher possibilities.

As to the curriculum of the higher schools and colleges, the problem is really not what studies shall be inserted and what omitted, but how shall we make it possible for the student to get that culture, efficiency and power out of his studies which his development requires. This is really a question for psychology to answer. Well may we ask of our universities with their psychological laboratories and their sensitive apparatus for measuring mental reactions: Will psychology ever accomplish what phrenology once promised but has never performed—the determination of a young student's capabilities and of the line of work he ought to pursue?

As to the elementary curriculum, surely we shall not go far wrong if we apply to each study and even to each detail of each study these four questions:

1. Is this study or this exercise well within the comprehension of the child?

2. Does it help to adjust him to the material and the spiritual environment of the age and the community in which he lives?

3. Does it combine with the other studies of the curriculum to render him more efficient in conquering nature and in getting along with his fellows, and thus to realize ideals that transcend environment?

4. Does it accomplish these objects better than any other study that might be selected for these purposes?

If these questions are answered in the affirmative, we may reasonably conclude that the study or the exercise in question is an important element in education for efficiency. Examined from the view point established by these questions, every study will assume an aspect very different from that which it bears when taught without a well defined object. Take drawing, for example. Drawing may be so taught as not only to lay bare to seeing eyes new worlds of beauty, but to lead to that reverent appreciation of nature and the reapplication of her lessons to daily industrial art which is the way, as Ruskin has said, in which the soul can most truly and wholesomely develop essential religion.

Again, take the teaching of agriculture. While our soil seemed inexhaustible in fertility as in extent, the need of such teaching was not felt. Now, however, we are obliged to have recourse to lands that produce only under irrigation. The rural schools have added to our difficulties by teaching their pupils only what seemed most necessary for success when they should move to the city. The farms of New

England are, in large measure, deserted or are passing into alien hands. To retain the country boy on the land and to keep our soil from exhaustion, it is high time that all our rural schools turned their attention, as some of them have done, to scientific agriculture. There is no study of greater importance. There is none more entertaining. If every country boy could become, according to his ability, a Burbank, increasing the yield of the fruit tree, the grain field and the cotton plantation, producing food and clothing where before there was only waste, what riches would be added to our country, what happiness would be infused into life! To obtain one plant that will metamorphose the field or the garden, ten thousand plants must be grown and destroyed. To find one Burbank, ten thousand boys must be trained, but unlike the plants, all the boys will have been benefited. The gain to the nation would be incalculable. Scientific agriculture, practically taught, is as necessary for the rural school, as is manual training for the city school.

Nor are our people going to rest satisfied with mere manual training. The Mosely commissioners pointed out that the great defect in American education is the absence of trade schools. Trade schools will inevitably come. The sooner the better. They are demanded for individual and social efficiency.

It is not in secondary schools alone, however, that efficiency demands highly differentiated types of schools. It is absurd to place the boy or girl, ten or twelve years of age, just landed from Italy, who can not read a word in his own language or speak a word of English, in the same class with American boys and girls five or six years old. For a time at least the foreigners should be segregated and should receive special treatment. Again, the studies that appeal to the normal boy only disgust the confirmed truant or the embryo criminal. Yet again, the mentally defective, the crippled and the physically weak children require special treatment. Unless all indications fail, the demand for education for efficiency will lead in all our large cities to the organization of many widely differentiated types of elementary school.

The problem of the curriculum, important as it is, is less important than the problem of the teacher. The born teacher, that is, the man or woman who has a genius for teaching, will teach well, in spite of any curriculum, however bad. Unfortunately, genius is as rare in the profession of teaching as it is in law, or medicine, or any other profession. The great majority of us, as it needs must be, are very common-place persons, who are seeking for light and doing the best we can. Hence the supreme importance of training. And yet there is no part of our work to which so little thought and investigation have been given. Normal schools in this country are still very young—only a little over half a century old. The first normal schools were

high schools with a little pedagogy thrown in. The majority of them remain the same to this day. There is a strong movement, however, toward purely professional schools to which no student who has not had a reasonably liberal education is admitted, and in which he shall devote his entire time to learning how to teach—how to observe, understand and exercise children both mentally and physically. Welcome and necessary as this movement is, if all teachers are to train for efficiency, we are still far from precise scientific notions as to the best methods of training teachers. I commend this subject to the National Council as one of the next investigations it should undertake.

To secure training for efficiency, the conditions of teaching must be such that each teacher shall be able to do his best work. By common consent one of these conditions is that teachers shall not be subjected to the ignominy of seeking political or other influence, or cringing for the favor of any man, in order to secure appointment or promotion. During the past year, two events have occurred which seem to be full of promise for the establishment of this condition. The public school teachers of Philadelphia have been freed from the bondage to ward politicians in which they were held for well nigh a century; and the one-man power, beneficent as such a system proved under a Draper and a Jones in Cleveland, has been supplanted by a seemingly more rational system. Independence of thought and freedom of initiative are necessary to the teachers of a nation whose stability and welfare as a republic depend upon the independence, the intelligence and the free initiative of its citizens. Independence of thought and freedom of initiative may be throttled by bad laws, but under the best of laws they will be maintained only by the teachers themselves. By making it unprofessional to seek appointment or promotion through social, religious or political influence, the teachers of this country have it in their power to establish one of the most essential conditions of education for efficiency.

Under the conditions that confront us, particularly in the large cities, with the rapid increase and constant migration of our home population, with the influx of vast hordes of people from abroad, alien in language, alien in modes of thought, and alien in tradition, the character of our elementary work is undergoing a profound transformation. We are beginning to see that every school should be a model of good housekeeping and a model of good government through cooperative management. What more may the schools do? They can provide knowledge and intellectual entertainment for adults as well as for children. They can keep their doors open summer as well as winter, evening as well as morning. They can make all welcome for reading, for instruction, for social intercourse, and for recreation. But I for one believe they may do still more. When I look upon the anemic faces and undeveloped bodies that mark so many of the children

of the tenements, when I read of the terrible ravages of tuberculosis in the same quarters, I can not but think that the city should provide wholesome food at the lowest possible cost in public school kitchens. To lay the legal burden of learning upon children whose blood is impoverished and whose digestion is impaired by insufficient or unwholesome feeding is not in accord with the boasted altruism of an advanced civilization or with the Divine command: Feed the hungry. Is this not also a subject for investigation by our National Council?

And should it some day come to pass that men will look upon corruption in public and corporate life, such as of late we have seen exposed in New York, Philadelphia and St. Louis, with the same loathing with which they regard crime in private life, it will be when the schools are in earnest about teaching our young people the fundamental laws of ethics, that

> **The ten commandments will not budge,**
> **And stealing still continues stealing.**

But economic perils and racial differences are the teacher's opportunity. Here in this country are gathered the sons and daughters of all nations. Ours is the task not merely of teaching them our language and respect for our laws, but of imbuing them with the spirit of self-direction, our precious inheritance from the Puritans; the spirit of initiative which comes to us from the pioneers who subdued a continent to the uses of mankind;* and the spirit of cooperation which is symbolized by and embodied in the everlasting union of sovereign states to promote the common weal. And as, in my own city, I see the eagerness of foreigners to learn, and the skill and devotion of our teachers, I can not but think that we are overcoming our almost insurmountable difficulties.

There is perhaps no more striking moment in all history than that at which the Apostle Paul, standing on Mars Hill and pointing to the blue Ægean, the center of the then known world, proclaimed the new but eternal doctrine: God hath made of *one* every nation of men for to dwell on all the face of the earth. Standing here as we do, on the border of the Atlantic Ocean, and beholding on the one side the dove of peace alighting from the hand of our President on the fields of carnage in the far east and on the other side the homes of peoples of all nationalities stretching from the Atlantic to the isles of the Pacific, under the protection of the American flag, may we not realize that we, as teachers, have a great part to perform in bringing a vast company to an understanding of the sublime truth that God has made all men *one* to dwell on the face of the earth—that their mission is not to defraud and to slay, but each to do his best for himself and to help his fellows.

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* Münsterberg, The Americans, Chapter I. and XI.

ADDRESS OF PRESIDENT ROOSEVELT BEFORE THE NATIONAL EDUCATIONAL ASSOCIATION.

I AM peculiarly pleased to have the chance of addressing this association, for in all this democratic land there is no more genuinely democratic association than this. It is truly democratic, because here each member meets every other member as his peer without regard to whether he is the president of one of the great universities or the newest recruit to that high and honorable profession which has in its charge the upbringing and training of those boys and girls who in a few short years will themselves be settling the destinies of this nation.

It is not too much to say that the most characteristic work of the republic is that done by the educators, by the teachers, for whatever our shortcomings as a nation may be—and we have certain shortcomings—we have at least firmly grasped the fact that we can not do our part in the difficult and all-important work of self-government, that we can not rule and govern ourselves unless we approach the task with developed minds, and with what counts for more even—with trained characters. You teachers make the whole world your debtors.

Of your profession this can be said with more truth than of any other profession, barring only that of the minister of the Gospel himself. If you—you teachers—did not do your work well this republic would not endure beyond the span of the generation.

Moreover, as an incident to your avowed work, you render some wellnigh unbelievable services to the country. For instance, you render to the republic the prime, the vital service of amalgamating into one homogeneous body the children alike of those who are born here and of those who come here from so many different lands lands abroad. You furnish a common training and common ideals for the children of all the mixed peoples who are being fused into one nationality. It is in no small degree due to you and to your efforts that we of this great American republic form one people instead of a group of jarring peoples. The pupils, no matter where they or their parents were born, who are being educated in our public schools will be sure to become imbued with that mutual sympathy, that mutual respect and understanding, which is absolutely indispensable for the working out of the problems we as people have before us.

And one service you render which I regard as wholly indispensable. In our country, where altogether too much prominence is given to the mere possession of wealth, we are under heavy obligations to such a body

as this, which substitutes for the ideal of accumulating money the infinitely loftier, non-materialistic ideal of devotion to work worth doing simply for that work's sake.

I do not in the least underestimate the need of having material prosperity as the basis of our civilization, but I most earnestly insist that if our civilization does not build a lofty superstructure on this basis, we can never rank among the really great peoples.

A certain amount of money is of course a necessary thing, as much for the nation as for the individual; and there are few movements in which I more thoroughly believe than in the movement to secure better remuneration for our teachers.

But, after all, the service you render is incalculable, because of the very fact that by your lives you show that you believe ideals to be worth sacrifice and that you are splendidly eager to do non-remunerative work if this work is of good to your fellow-men.

To furnish in your lives such a realized high ideal is to do a great service to the country. The chief harm done by the men of swollen fortune to the community is not the harm that the demagogue is apt to depict as springing from their actions, but the fact that their success sets up a false standard, and so serves as a bad example for the rest of us. If we did not ourselves attach an exaggerated importance to the rich man who is distinguished only by his riches, this rich man would have a most insignificant influence over us.

I want to interject something here that will make you keep your mind on the real meaning of my words. I am speaking of the rich man who thinks only of his riches, not of the rich man who uses his wealth rightly and regards it as means to an end. It is well, in this connection, to remember the explanation of the parable in the Bible about the difficulty encountered by the rich man who wants to get into heaven. It says that such entrance shall be difficult for 'the rich man who trusteth in his riches.' I am here talking just of rich men who trust in their riches, not of those who are good citizens and first-class men, for those of the latter class are entitled to the same respect as any other men.

It is generally our own fault if he does damage to us, for he damages us chiefly by arousing our envy or by rendering us sour and discontented. In his actual business relations he is much more apt to benefit than harm the rest of us, and, though it is eminently right to take whatever steps are necessary in order to prevent the exceptional members of his class from doing harm, it is wicked folly to let ourselves be drawn into any attack upon the wealthy man merely as such. Remember that, you teachers. It is just as wicked to attack men of wealth as such as it is to attack the man of poverty as such. And, furthermore, the man rendered arrogant by the possession of wealth is precisely the man who,

if he did not have it, would hate with envious jealousy the man who had it. And remember, also, that both sides of this shield are true.

The man roused into furious discontent and envy because he sees other men better off than himself would most decidedly misbehave himself if he got wealth. Moreover, such an attack is in itself an exceptionally crooked and ugly tribute to wealth, and therefore the proof of an exceptionally ugly and crooked state of mind in the man making the attack. Venomous envy of wealth is simply another form of the spirit which in one of its manifestations takes the form of cringing servility toward wealth, and in another the shape of brutal arrogance on the part of certain men of wealth. Each one of these states of mind, whether it be hatred, servility or arrogance, is in reality closely akin to the other two, for each of them springs from a fantastically twisted and exaggerated idea of the importance of wealth as compared to other things.

The clamor of the demagogue against wealth, the snobbery of the social columns of the newspapers which deal with the doings of the wealthy, and the misconduct of those men of wealth who act with brutal disregard of the rights of others seem superficially to have no fundamental relation; yet in reality they spring from shortcomings which are fundamentally the same, and one of these shortcomings is the failure to have proper ideals. The community that cherishes such ideals and that admires most the men who approximate most closely to those ideals—in that community we shall not find any of these unhealthy ideas of wealth.

This failure must be remedied in large part by the actions of you and your fellow-teachers, your fellow-educators throughout this land. By your lives, no less than by your teachings, you show that, while you regard wealth as a good thing, you regard other things as still better. It is absolutely necessary to earn a certain amount of money; it is a man's first duty to those dependent upon him to earn enough for their support, but after a certain point has been reached money-making can never stand on the same plane with other and nobler forms of effort.

The roll of American worthies numbers men like Washington and Lincoln, Grant and Farragut, Hawthorne and Poe, Fulton and Morse, St. Gaudens and MacMonnies; it numbers statesmen and soldiers, men of letters, artists, sculptors, men of science, inventors, explorers, road-makers, bridge builders, philanthropists, moral leaders in great reforms; it numbers all these and scores of others; it numbers men who have deserved well in any one of countless fields of activity; but of the rich men it numbers only those who have used their riches aright, who have treated wealth not as an end but as a means, who have shown good conduct in acquiring it and not merely lavish generosity in disposing of it.

And thrice fortunate are you to whom it is given to lead lives of resolute endeavor for the achievement of lofty ideals, and, furthermore,

to instill, both by your lives and by your teachings, these ideals into the minds of those who in the next generation will, as the men and women of that generation, determine the position which this nation is to hold in the history of mankind.

And now, in closing, I want to speak to you of certain things that have occurred during the last week and of how those things emphasize what I have just said to you as to the importance of this country having within its limits men who put the realization of high ideals above any form of money making. During this week our country has lost a great statesman who was also a great man of letters, a man who occupied a peculiar and unique position in our community, a man of whose existence we could each of us be proud because his life reflected upon each of us; for the United States as a whole was better because John Hay lived. John Hay entered the public service as a young man just come of age, as the secretary of President Lincoln. He served in the war, he was a member of the Loyal Legion. He was trusted by and was intimate with Lincoln as hardly any other man was. He then went on rendering service after service, and of his merits this was one of them: He had the great advantage and great merit of always being able at any moment to go back to private life unless he could continue in public life on his own terms. He went on rendering service after service to the country until as the climax of his career he served for some six years as secretary of state in two successive administrations, and by what he did and by what he was contributed in no small degree to achieve for this republic the respect of the nations of mankind. Such service as that could not have been rendered save by a man who had before him ideals as far above as the poles from those ideals which have in them any taint of what is base or sordid.

I wished to get for John Hay's successor the man whom I regarded as of all the men in the country that one best fitted to be such successor. In asking him to accept the position of secretary of state I was asking him to submit to a very great pecuniary sacrifice, and I never even thought of that aspect of the question, for I knew he wouldn't, either. I knew that whatever other consideration he had to waive for and against taking the position, the consideration of how it would affect his personal fortune would not be taken into account by Elihu Root. And he has accepted.

And now I am not speaking of Hay and Root as solitary exceptions. On the contrary, I am speaking of them as typical of a large class of men in public life, and when we hear so much criticism of certain aspects of our public life and of certain of our public servants, criticism which I regret to state is in many cases deserved, it is well for us to remember also the other side of the picture, to remember that here in America we now have and always have had at the command of the

nation in any crisis, in any emergency, the very best ability to be found within the nation, and that ability given with the utmost freedom, given lavishly and generously, although to the great pecuniary loss of the man giving it. There is not in my cabinet a man to whose financial disadvantage it is not to sit in the cabinet. There is not in my cabinet one man who does not have to give up something substantial, very largely substantial sometimes, that it is a very real hardship for him to give up, in order that he may continue in the service of the nation, and have the only reward for which he looks or for which he cares, the consciousness of having done service that is worth rendering.

And I hope more and more throughout this nation to see the spirit grow which makes such service possible. I hope more and more to see the sentiment of the community as a whole become such that each man shall feel it borne in on him, whether he is in public life or in private life—mind you, some of the very greatest public services can be best rendered by those who are not in public life—that the chance to do good work is the greatest chance that can come to any man or any woman in our generation, or in any other generation. That if such work can be well done it is in itself the amplest reward and the amplest prize.

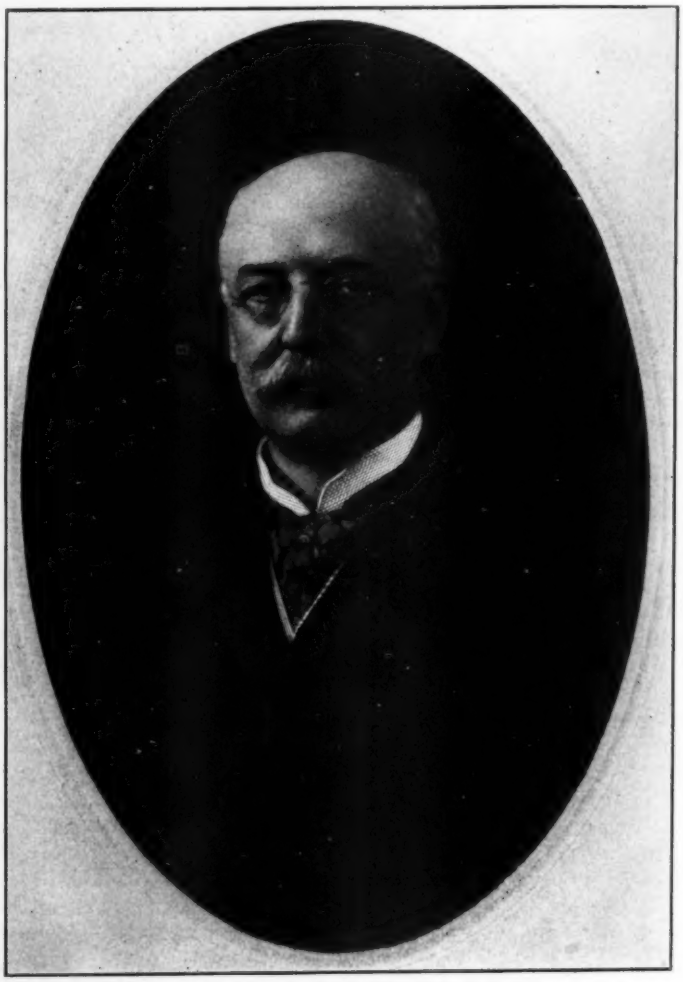
THE PROGRESS OF SCIENCE.

THE NATIONAL EDUCATIONAL ASSOCIATION.

THE National Educational Association held one of its great assemblages on the New Jersey coast during the first week of July. No official report of the registration was given out, but the attendance was estimated at 15,000, some newspapers placing it as high as 20,000. The association has been called an institute for the promotion of summer travel, and this is certainly one of its functions. Favorable arrangements are made with the railways, and teachers with their relations and friends are thus enabled to enjoy a trip of which the meeting is only an incident. Under these conditions the attendance has increased in an extraordinary manner. The registration was only 625 at the Saratoga meeting of 1885. At the previous Asbury Park meeting of 1894 it was 5,915. At the subsequent meetings it has been as follows. Denver, 11,297; Buffalo, 9,072; Milwaukee, 7,111; Washington, 10,533; Los Angeles, 13,656; Charleston, 4,641; Detroit, 10,182; Minneapolis, 10,350; Boston, 34,984; St. Louis, 8,109.

Asbury Park and Ocean Grove offered an attractive place of meeting to those who wished to visit the cities, the seaside or the mountains of the Atlantic seaboard, and in addition to the usual features of the program, addresses were made by the mayor of New York City and the president of the United States. Dr. W. H. Maxwell delivered on the first day the presidential address, which we are able to print in advance of its publication in the proceedings. Dr. Maxwell, who came to this country from Ireland at the age of twenty-two, was assistant superintendent and then superintendent of the Brooklyn schools, and has since 1898 been head of the public school system of Greater New York. This is the most responsible educational position in the country. There are in New York City nearly one million children of school age, and the annual budget for the public schools is about $30,000,000. Compared with the vast responsibility of administering this system, the presidency of Harvard University or the commissionership of education is comparatively unimportant. The responsibility is obviously increased by the political conditions and by the fact that in New York City are enormously emphasized the two increasing difficulties of education, to which Dr. Maxwell referred in his address—the crowding into cities and the quantity and quality of immigration.

In addition to addresses by the president of the association, by President Roosevelt and by Mayor McClellan, there were a number of papers presented before the general sessions. Dr. W. T. Harris, U. S. Commissioner of Education, without whom a meeting of the association would be incomplete, read a paper on 'The Future of Teachers' Salaries'; Dr. Andrew S. Draper, state commissioner of education, spoke of 'The Nation's Educational Purpose'; Mr. William Barclay Parsons, the eminent New York engineer, discussed 'The Practical Utility of Manual and Technical Training'; the question of child labor and compulsory education was treated by Mr. George H. Martin, secretary of the Massachusetts State Board of Education, and by Dr. Franklin P. Giddings, professor of sociology at Columbia University, who considered the perplexing topic of the relation of compulsory education and the prohibi-



WILLIAM HENRY MAXWELL, SUPERINTENDENT OF SCHOOLS, THE CITY OF NEW YORK, PRESIDENT OF THE NATIONAL EDUCATIONAL ASSOCIATION.

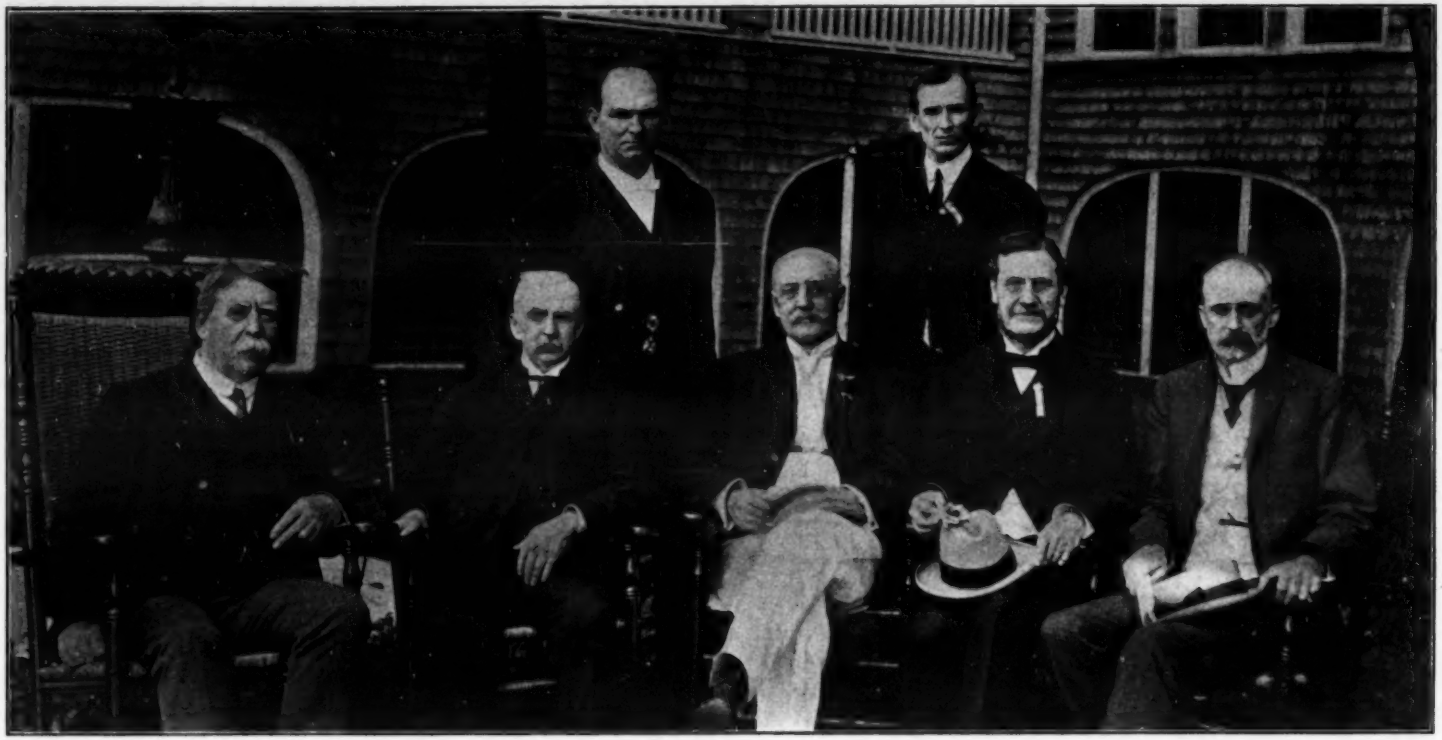
tion of child labor to the decrease of the birth rate.

In addition to the general sessions, there was the usual meeting of the National Council of Education, which consists of sixty of the more active members of the association and holds sessions of general interest. There are, further, departments of kindergarten education, elementary education, secondary education, higher education, normal schools, manual training, art training, musical training, business training, child-study, science instruction, physical education, school administration, library, special education and Indian education, all of which presented programs.

At the meetings of the National Educational Association there is a vast flood of platitudes annually poured out, but when there are practical questions to be discussed, the proceedings become at once more interesting and more scientific. The teachers are taking an increasing interest in all questions con-

nected with administration, and perhaps more especially in those relating to salaries, tenure of office, pensions and the like. At the recent meeting President Carroll D. Wright, of Clark College, presented the report of the committee appointed to consider these questions, giving valuable statistics shortly to be published. There are in the United States nearly 600,000 teachers, and it appears not unlikely that the National Educational Association will develop into a trades union representing their interests. The average salary, including the highest paid for supervision and the like, is said to be $300 a year. President Roosevelt, in his address which is printed above, told his audience of 10,000 teachers that they were performing an incalculable service by the very fact that they believed ideals to be worth sacrifice and that they were eager to do non-remunerative work. The speaker prefaced these remarks with the statement that he believed in the movement to secure better remuneration for teachers. The rhetorical effect would have been better if the order of the sentiments had been reversed, for the audience cheered continuously for several minutes the first statement, while they listened to the latter in silence; and we are inclined to think that the teachers are right. The illustrations of men such as John Hay and Mr. Elihu Root, who were stated by the president to have sacrificed their material interests for the nation, can only carry a limited weight, when the teachers reflect on the great wealth acquired by these men, in part, at least, as the result of political affiliations.

The Rev. Dr. Nathan C. Schaeffer, state superintendent of public instruction in Pennsylvania, was elected president of the association, and it is expected that the place of meeting next year will be San Francisco. It is understood that in this case the group that manages the association was defeated; there is naturally a certain amount of politics in such an institution. Some complaints are heard that the association is not sufficiently democratic, and that the present methods of administration will be made permanent by the charter that it was voted to secure from congress. It is inevitable that an association of this character should be managed by a small group who maintain a permanent interest in the work, and it is also probable that one man will be dominant. So far as we are aware, the group in control has acted wisely, and the democratic character of the association is maintained so long as this group can be defeated or a new group placed in power, should this meet the wishes of the majority. The constitution, which it will be extremely difficult to alter if once adopted as a bill passed by congress, lodges the control in a board of directors, which consists of the officers, the past presidents, certain life-directors, who we believe purchased the position for $100, and one member elected from each state. These officers are nominated by a committee containing one representative from each state or territory, elected by the active members of each state. There is, however, at least one state with only two active members, and it does not seem entirely democratic to place such a state against the hundreds of members representing New York or Illinois. Further, if a member is not elected by the state, the appointment is made by the president, and hitherto the constitution of the nominating committee and of the board of directors has been dictated by a small group of men. A more democratic form of government would probably be secured if the active members elected their representatives by ballot, which could be sent through the mail, and if the number of representatives were proportionate to the number of active members in each state.



SOME LEADING MEMBERS OF THE NATIONAL EDUCATIONAL ASSOCIATION.

In the center of the group is Dr. W. H. Maxwell, president of the association; at his right, Dr. Irwin Shepard, secretary; on the left of the picture is Dr. F. Louis Soldan, superintendent of instruction, public schools, St. Louis, Mo.; on the right are Albert G. Lane, assistant superintendent of schools, Chicago, Ill. and Dr. James N. Green, principal of the State Normal School, Trenton, N. J.; standing on the left is Charles D. McIver, of the State Normal and Industrial College, Greensboro, N. C., and on the right, James W. Crabtree, president of the State Normal School at Peru, Nebr.

THE COLLEGE COURSE.

THAT the question of the college course is not solved is proved by the changes continually being made in the programs of studies. The seven leading universities in the east are Harvard, Yale, Columbia, Cornell, Princeton, Pennsylvania and Johns Hopkins. Harvard has consistently maintained the free elective system and Johns Hopkins the group system, but the other five institutions have recently revised their requirements for the undergraduate course and the bachelor's degree. Cornell has formed one college of arts and sciences and gives the A.B. degree to all students for a free elective course extending through four years. The ancient languages are not required either before or after entrance, and Cornell is thus more consistent than Harvard, where the A.B. degree means that Latin was studied in the preparatory school and the B.S. that it was not. Cornell requires sixty hours of work and insists on four years of residence; Harvard requires fifty-four hours and rather favors three years of residence; Harvard requires the bachelor's degree for entrance to its professional schools; Cornell permits students to take the fourth year of the college course as the first year in the medical or law course.

Pennsylvania now confers the A.B. degree only on students who take both Latin and Greek for one year in college and the B.S. degree on the others. It requires sixty hours' attendance, which may be accomplished in three or four years. Of these hours twenty-two are required, eighteen are group studies and twenty are free electives. One half year of college work may be in the department of medicine. Like Pennsylvania, Yale has altered its program of studies in the direction of the group system. Students of the college must offer Latin at entrance, but need not continue its study. Sixty hours are required for the degree, and they must include two 'majors' and three 'minors.' One year of work may count for both the professional and college degrees, and the college course may be completed in three years. The Sheffield Scientific School offers both liberal and engineering courses. Curiously enough, Latin is required for entrance, the course is three years, and the degree of bachelor of philosophy is awarded.

Princeton has this year adopted an entirely new program of studies. A third degree, Litt.B., has been added. The arrangement is logical, in so far as candidates for the A.B. degree must take Latin and Greek for two years, candidates for the B.S. degree must specialize in science and candidates for the Litt.B. degree in languages, philosophy, history or art. Latin is required for entrance to all courses. The studies of the freshman year are completely, and those of the sophomore year are partly, prescribed, and the rest of the four years' course is arranged on a group system. The tutorial system of the English colleges is to be introduced. Princeton aims to return to the old-fashioned college, and may be congratulated on the fairly consistent methods that it has adopted. The experiment in one of our larger institutions will be followed with interest.

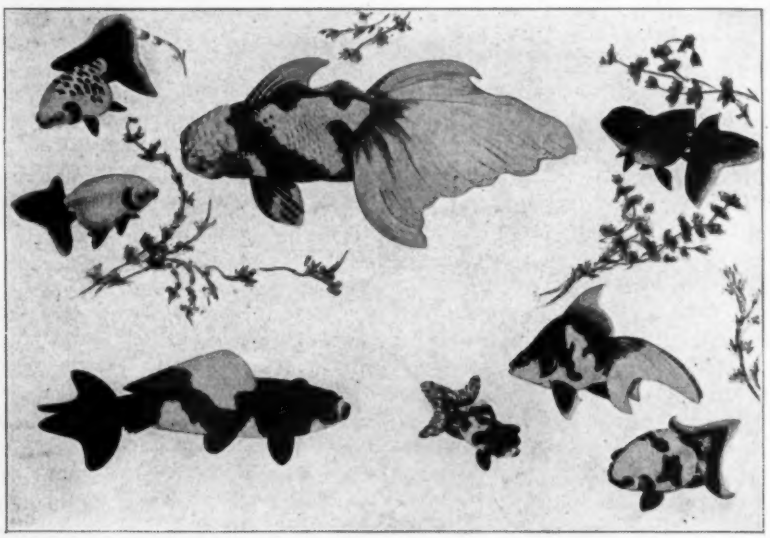
Columbia has also adopted a new program of studies. A B.S. degree has been established for students who enter without Latin, but no plans have been made for a course in the sciences. The B.S. students take one course in science in place of a course in Latin, but as nearly all A.B. students elect a course in science and very few of them elect any course in Latin or Greek, the only distinction between the A.B. candidates and the B.S. candidates is that the former have probably forgotten the small Latin they once learned, whereas the latter have probably never learned any Latin. An extreme form of the *table d'hôte* system is adopted in the first two years, all freshmen being required to take seven unrelated studies; while in the last two years an

extreme form of the *à la carte* system is adopted, no groups being required except in the professional schools, even the graduation theses being abolished. Students may take the last two years of the bachelor's course in the professional school, and as they may enter at mid-year and receive a credit of one half year on the entrance examinations, they may obtain the A.B. degree for a college residence of one and a half years. Students receive extra credits for high standing and deductions for low standing, the excellent system being thus introduced of letting quality of work as well as hours of attendance count for the degree.

The unstable equilibrium of the college course is doubtless an indication of progress. There is no reason why an institution such as Harvard or Columbia should not adopt the different programs which are supported by good educational authority and maintain them side by side. At the English universities, a student may take the 'poll' course or an honors course; he may specialize to any extent or elect freely; he may follow a fixed course of tuition or engage in research; he may receive the B.A. degree for work in medicine or engineering; he may be in residence three years or five. There is no obvious objection to maintaining in the same institution the free elective system of Harvard, the culture group system of Princeton, and the special group system of the Johns Hopkins.

THE CUTIVATION OF MARINE AND FRESHWATER ANIMALS IN JAPAN.

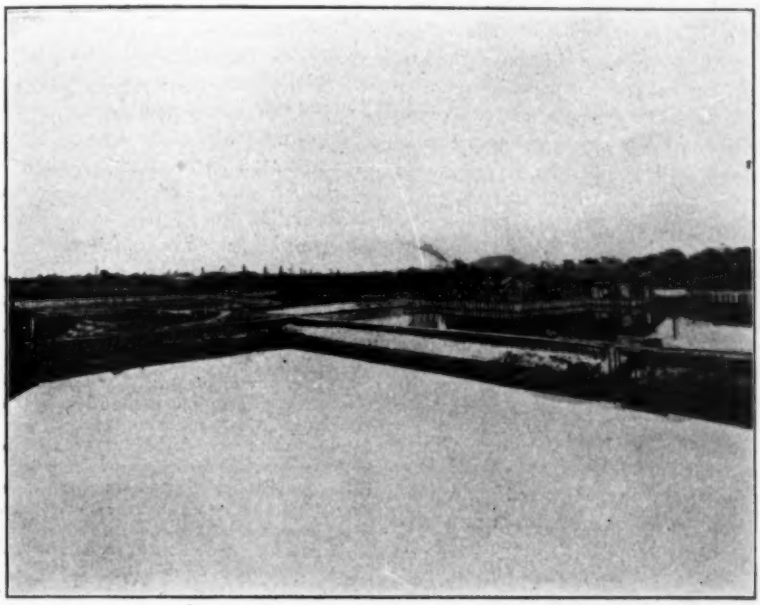
Professor Mitsukuri, of the Imperial University of Tokyo, presented before the International Congress of Arts and Science a paper on the cultivation of marine and freshwater animals in Japan, which has now been printed by the Bureau of Fisheries. Professor Mitsukuri calls attention to the fact that the cultivation of aquatic animals is not only a matter that will have increasing economic importance,



Varieties of Gold-Fish (from Japanese Paintings).

Lower left, wakin; lower right (group of three), demé, ryukin, ranchu; upper left (two), ranchu; upper middle and right, oranda shishigashira.

but also opens an opportunity for valuable scientific investigation. Dissection in the laboratory and histological examination can not tell us all that we need to know about animals. This we can easily realize if we consider what our knowledge of man would be if it were confined to the results of the dissecting room. Our bureau of fisheries is in many ways setting an example to other nations, but we shall probably find that in the near future Japan will surpass us and every other nation in the intensive breeding and rearing of animals living in the water. Indeed, in some ways they appear already to have accomplished this. For example, there are complaints of the disappearance of the diamond-back terrapin, but apparently no efforts are made to rear it. In Japan the soft-shelled turtle is reared and sold in large numbers. The accompanying illustration shows the turtle farm of the Hattori family, near Tokyo. In 1866 the first large turtle was caught; by 1874 the number reached fifty, and in the following year breeding was begun. Over one hundred young were hatched the first year, but nearly all of them were devoured by their parents. It thus became necessary to have separate ponds for the young of the first year and of the second year, while those of the third, fourth and fifth years might be mixed. Last year the farm raised about 70,000 turtles, and it is expected that about 60,000 of them will be reared. When three years old, they are sold in the markets of Tokyo for a price in the neighborhood of forty cents each.



VIEW OF A TURTLE FARM, FUKAGAWA, TOKYO, JAPAN.

Goldfish have for a long time been bred in Japan, being perhaps the most characteristic oriental fish. The accompanying illustration shows some of the types raised, as depicted by Japanese artists. The extreme plasticity of this fish and the types that are developed by selection are of very considerable scientific interest and would doubtless serve well for the

study of Mendel's law and the mutations of de Vries. The monograph describes the breeding of the eel, the gray mullet, the oyster and other forms. As Professor Mitsukuri says: "While the pasturage of cattle and the cultivation of plants marked very early steps in man's advancement toward civilization, the raising of aquatic animals and plants, on any extensive scale at all events, seems to belong to much later stages of human development. In fact, the cultivation of some marine animals has been rendered possible only by utilizing the most recent discoveries and methods of science. I believe, however, the time is now fast approaching when the increase of population on the earth, and the question of food supply which must arise as a necessary consequence, will compel us to pay most serious attention to the utilization for this purpose of what has been termed the 'watery waste.' For man to overfish and then to wait for the bounty of nature to replenish, or, failing that, to seek new fishing grounds, is, it seems to me, an act to be put in the same category with the doings of nomadic peoples wandering from place to place in search of pastures. Hereafter, streams, rivers, lakes and seas will have, so to speak, to be pushed to a more efficient degree of cultivation and made to yield their utmost for us. It is, perhaps, superfluous for me to state this before an audience in America, for I think all candid persons will admit that the United States, with her Bureau of Fisheries, is leading other nations in bold scientific attempts in this direction."

SCIENTIFIC ITEMS.

WE regret to record the death of Dr. Wm. Thos. Blanford, F.R.S., the well-known British geologist, and of Mr. Geo. H. Eldridge, geologist of the U. S. Geological Survey.

THE Berlin municipality has appropriated $20,000 to erect a statue in honor of Rudolf Virchow, which will be placed on the Karlsplatz, close to the Charity Hospital.—The faculty and students of the medical and dental departments of the George Washington University have erected, in the main hall of the department of medicine, a bronze tablet to the memory of their late dean and professor of chemistry and toxicology, Dr. Emil Alexander de Schweinitz.

AT a meeting of the General Education Board, held on June 30, a gift of ten million dollars was announced from Mr. John D. Rockefeller, as an endowment for higher education in the United States. The announcement of the gift was made in a letter from Mr. Frederick T. Gates, Mr. Rockefeller's representative, which reads as follows:

I am authorized by Mr. John D. Rockefeller to say that he will contribute to the General Educational Board the sum of $10,000,000 to be paid October 1 next in cash, or, at his option, in income producing securities, at their market value, the principal to be held in perpetuity as a foundation for education, the income, above expenses and administration, to be distributed to or used for the benefit of such institutions of learning at such times, in such amounts, for such purposes and under such conditions, or employed in such other ways as the Board may deem best adapted to promote a comprehensive system of higher education in the United States.

Mr. Rockefeller has also given one million dollars to Yale University.